PB-226 276

ENVIRONMENTAL IMPACT STATEMENTS: A HANDBOOK FOR WRITERS AND REVIEWERS

UNIVERSITY OF ILLINOIS

AUGUST 1973

BIBLIOGRAPHIC DATA SHEET	1. Report No. IIEQ 73-8	2.	3. Recipient's Accession No. PB-226 276
4. Title and Subtitle Environmental Impact Statements: A Handbook for Writers and Reviewers			5. Report Date August 1973 6.
7. Author(s) Lewis D. Hopkins, Et Al			8. Performing Organization Rept. No.
9. Performing Organization Name and Address Department of Landscape Architecture University of Illinois Urbana-Champaign, Illinois			10. Project/Task/Work Unit No. 80.007 11. Contract/Grant No.
12. Sponsoring Organization Name and Address IL. Institute for Environmental Quality 309 W. Washington Chigago, IL., 60606			13. Type of Report & Period Covered FINAL 14.

15. Supplementary Notes

16. Abstracts

This Handbook was prepared for writers and reviewers of Environmental Impact Statements (EIS) in the state of Illinois. It provides a basic introduction to the preparation of these statements, and gives suggestions for content, organization, and format of presentation. This report is directed at impact statements for projects of concern at athe state, rather than local or federal, level; e.g. Reservoirs, stream channelization, highway links, mining operations, and public facility location.

There are four basic sections to the handbook: Chapter I suggests an organization for the writing of impact statements; Chapter II reviews environmental impact assessment methods: Chapter III gives annotated examples of impact statements; Chapter IV lists important sources of information concerning environmental effects in the state of Illinois.

17. Key Words and Document Analysis. 17a. Descriptors

Environmental Engineering
Impact Statements

17b. Identifiers/Open-Ended Terms

Environmental Impact Statements

17c. COSATI Field/Group 13B. Civil Engineerings

18. Availability Statement	19. Security Class (This Report)	21. No. of Pages
Release Unlimited Available from NTIS	UNCLASSIFIED	
	20. Security Class (This Page) UNCLASSIFIED	22. Price

PORTIONS OF THIS REPORT ARE NOT LEGIBLE.

HOWEVER, IT IS THE BEST REPRODUCTION

AVAILABLE FROM THE COPY SENT TO NTIS

ia

ENVIRONMENTAL IMPACT STATEMENTS:

A HANDBOOK FOR WRITERS AND REVIEWERS

PREPARED BY
THE DEPARTMENT OF LANDSCAPE ARCHITECTURE
UNIVERSITY OF ILLINOIS
URBANA-CHAMPAIGN

Project Director

Lewis D. Hopkins
Assistant Professor
Department of Landscape Architecture

Project Staff

R. Bruce Wood
Department of Geography

Debra Brochmann
Louis Messina
Department of Landscape Architecture

STATE OF ILLINOIS

ILLINOIS INSTITUTE FOR ENVIRONMENTAL QUALITY

Dan Walker, Governor
Samuel G. Booras, Director

AUGUST 1973

Note

This report has been prepared and reproduced by the consultant. No editorial or other changes have been made. Conclusions expressed in this handbook are those of the consultants.

Printed by authority of the State of Illinois
Date Printed: August 31, 1973
Quantity Printed: 400

Illinois Institute for Environmental Quality
309 West Washington Street
Chicago, Illinois 60606

This handbook has been prepared for writers and reviewers of environmental impact statements (EIS) in the State of Illinois to help fill the need for basic introductory materials on how to write impact statements.

It provides suggestions and should serve as a reference for content, organization, and format of presentation. It is particularly aimed at the reviewing activities of the task force of the Natural Resources Development Board charged with reviewing statements for the state, and at staff in state agencies who are writing statements, reviewing statements from other agencies, or contracting to have statements written. The examples used and the ideas developed are designed to be particularly relevant to impact statements for projects of significant concern at the state, rather than local or federal levels; these include reservoirs, stream channelization, highway links, mining operations, and public facility location.

The handbook is organized in four distinct sections which may in toto be viewed as a brief introductory instruction manual. Each of the sections, and in particular Chapter III, also stands alone as a reference source. First, in Chapter I, an organization is suggested for the writing of impact statements. It is based on section 102(C) of the National Environmental Policy Act, but does not adhere exactly to the outline provided in the act and therefore yields a more readable, less redundant EIS. Second, in Chapter II, environmental impact assessment methods and their application, including reference information on checklists, analytical frameworks, and evaluation, are reviewed. Third, in Chapter III, a set of examples illustrating successful and unsuccessful attempts to fulfill the requirements of the act is given so as to illustrate interpretations, organization, and content. Finally, in Chapter IV, a listing of important sources of information concerning environmental effects for the State of Illinois is provided.

1

I

GUIDELINES FOR

ORGANIZATION, CONTENT, FORMAT

To the discomfort of many writers and reviewers of Environmental Impact Statements (EIS), section 102(C) of the National Environmental Policy Act (NEPA) has long been viewed as a verbatim model for the structuring of Environmental Impact Statements.

> (C) include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible officials on--
>
> (i) the environmental impact of the proposed action,
> (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
> (iii) alternatives to the proposed action,
> (iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of the long-term productivity, and
> (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed actions should it be implemented.
>
> Prior to making any detailed statement, the responsible Federal official shall consult with and obtain comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statements and the comments and views of the appropriate State, and local agencies, which are authorized to develop and enforce environmental standards, shall be made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review process.

Due to the wide range of application for which section 102(C) is intended, problems of definition have been left to the individual agencies. As a result of shoestring budgets, a lack of precedents, and staffing problems, concrete guidelines for the writer of EIS have appeared very slowly. Accordingly,

statements are often vague and repetitive, and lack clarity and structure essential for effective review.

The original intent of NEPA's 102(C) was to indicate the types of questions which were to be answered through the use of scientific data, not to provide a statement outline. The hope was to point out the probability of gross environmental damage before it occurred in order to prevent such ecological disasters as the dispersal of DDT into all facets of the food chain.

Section 102(C) has five subsections, each implied to be of equal significance. Figure 1 describes the present interpretation of 102(C) as an outline for an EIS. This is also suggestive of the typical table of contents of most EIS. The most obvious problem is the lack of continuity. For example, the discussion of future impacts is abruptly interrupted by the consideration of alternatives. One has to reflect back to the present condition in order to evaluate the alternatives. The discussion of alternatives comes between the discussion of unavoidable impacts and the discussion of related aspects of future conditions. The result is a confused reader unable to integrate the segmented facts in order to make an independent decision.

It is apparent that a new organizational structure is needed. A closer look at the five subsections of 102(C) and a comparison of the interpretations given them by different agencies should help to make clearer the basis for a reorganization.

Sub-section (i) of 102(C) requires a statement of "the environmental impact of the proposed action." Note, for instance, the interpretations given to this sub-section in the Council on Environmental Quality (CEQ) Guidelines of April 23, 1971, and the Environmental Protection Agency (EPA) Guidelines of Region X.

TYPICAL OUTLINE FOR CURRENT EIS

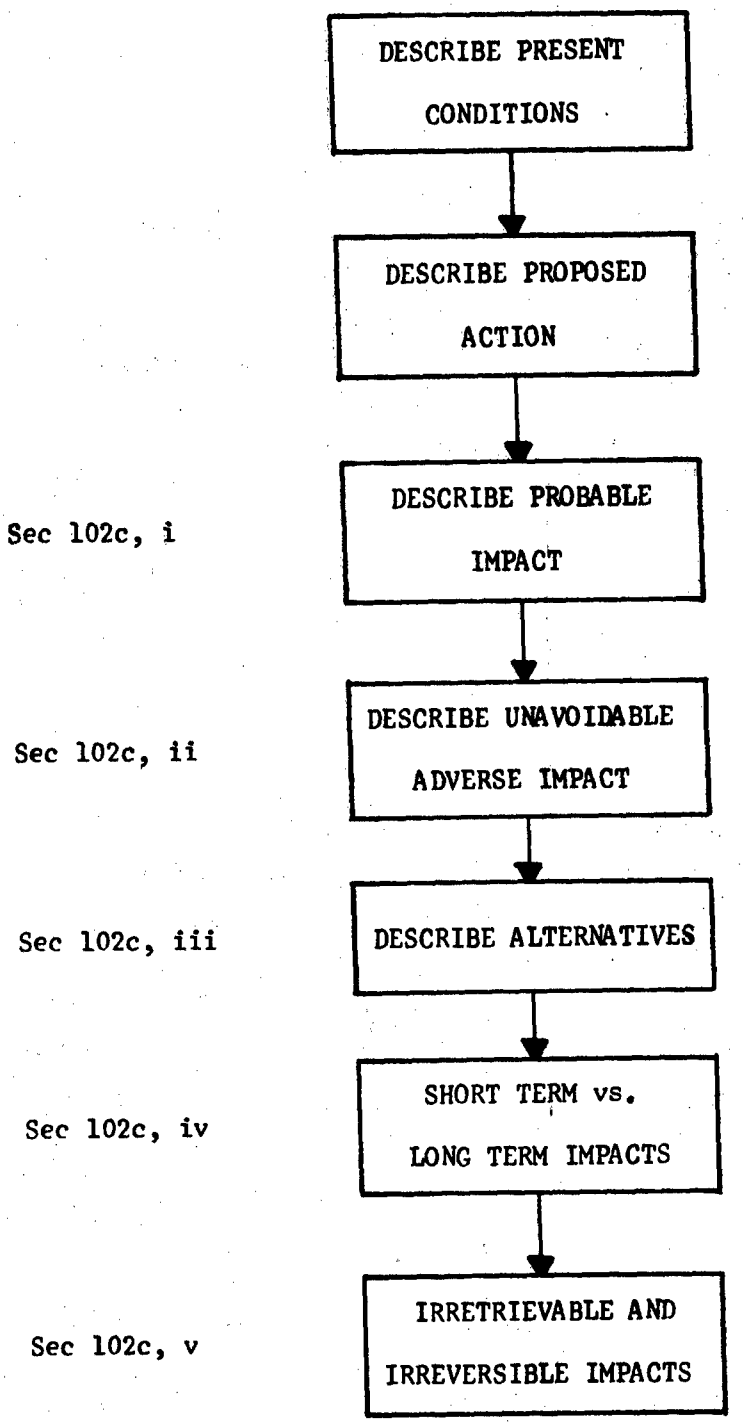


Figure 1 - Typical outline for current EIS

PRESENT INTERPRETATIONS OF NEPA 102(C), (i) and (ii)

Sub-section (i)

102(C)
the environmental impact of the proposed action

CEQ 4/23/71
(i) a description of the proposed action including information and technical data adequate to permit a careful assessment of environmental impact by commenting agencies. Where relevant, maps should be provided.

(ii) the probable impact of the proposed action on the environment, including impact on ecological systems such as wildlife, fish, and marine life. Both primary and secondary significant consequences for the environment should be included in the analysis. For example, the implication, if any, of the action for population distribution or concentration should be estimated and an assessment made of the effect of any possible change in population patterns upon the resource base, including land use, water, and public services, of the area in question.

EPA, Region X
Point (1) requires a description of primary and secondary impact on the environment including impacts on aesthetics, and aquatic and terrestrial ecosystems.

Sub-section (ii)

102(C)
any adverse environmental effects which cannot be avoided should the proposal be implemented.

CEQ 4/23/71
(iii) any probable adverse environmental effects which cannot be avoided such as water or air pollution, undesirable land use patterns, damage to life systems, urban congestion, threats to health or other consequences adverse to the environmental goals set out in section 101(B) of the Act.

EPA, Region X
Point (2) requires a description of any probable impact on the environment, including impact on ecological systems such as wildlife, fish, and marine life.

Examining this point, one first notices the ambiguity that exists between CEQ's section (i) and (ii). A more concrete distinction is needed between the "probable impact of the proposed action" vs. the "description of the proposed action."

A description of the proposed action must include specifics of the area and resources involved, the physical changes proposed, and the time frame within which these changes will occur. For example, a proposal for a reservoir project must include quantities of water to be stored, size of the area affected, amounts and schedules of releases, population served, and date of completion. If a hydroelectric plant is to be constructed by a public utility company subject to license by the Federal government, then information on such a facility should be included in the description. In other words, a description should provide a general overview of the proposed project so that the reader with working knowledge of the area affected can understand how the proposed action relates to the region.

A description of the probable impact of a proposed action requires a description of "primary and secondary impacts" ... including impacts on aesthetic, socio-economic, and ecological systems. The CEQ Guidelines state that significant impacts include those which have both detrimental and beneficial effects "even if, on the balance, the agency believes that the effect will be beneficial." The EIS should therefore consider and report <u>all</u> alterations to existing conditions whether or not they are deemed beneficial or detrimental.

This section also requires a description of the environmental interrelationships in the direct project area and the total affected area, however extensive it may be. A major action, such as a storage reservoir, a mining operation, road construction, or recreation development, not only may affect air, soil, vegetation, and water quality in the immediate project area, but also may be the inducement needed for industrial, recreational, or agricultural development with attendant

environmental impacts. One must be alert to such total area impacts and consider all possible implications of the proposed action.

A description of the proposed action is not required by 102(C), but it is obviously necessary to provide independent review by other agencies and the public. The objective is not merely to provide enough data to familiarize the reader with the project, but to present a total picture for accurate assessment. To develop relative measures of impacts from a proposed project when one is not aware of the alternatives which exist, and the impact they have on the environment, is difficult. The biased presentation which results from not describing the range of alternatives precludes the reviewer of the EIS from making an independent judgment.

Let us briefly consider 102(C) sub-section (ii), "unavoidable adverse environmental effects." A situation is unavoidable only if all the alternatives have been eliminated. To consider unavoidable impacts before a discussion of alternatives puts the cart before the horse. Therefore, the case for alternatives preceding other considerations, particularly probable and unavoidable impacts, is again emphasized.

Sub-section (ii) of 102(C) is fairly self-explanatory according to the guidelines on page 5. EPA Region X's interpretation of point (2) is virtually no different from point (1). Any probable adverse environmental effects which cannot be avoided should the proposed action be implemented, such as water or air pollution, undesirable land use patterns, damage to life systems, urban congestion, threats to health or other consequences adverse to the environment, should be described. This should include any potentially harmful physical, biological, social, and economic consequences. Adverse effects should include those which cannot be reduced in severity and those which can be reduced (but not eliminated) to an acceptable level. It is not

surprising that unavoidable adverse impacts seem to be a repetitive subset of probable impacts.

Sub-section (iii) concerns alternative actions and is fairly well defined by the EPA and CEQ guidelines.

PRESENT INTERPRETATION OF NEPA 102(C), (iii).

102(C)
alternatives to the proposed action

CEQ 4/23/71
(iii) alternatives to the proposed action (section 102 (2) D of the Act requires the responsible agency to "study, develop, and describe appropriately alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources"). A rigorous exploration and objective evaluation of alternative actions that might avoid some or all of the adverse environmental effects is essential. Sufficient analysis of such alternatives and their costs and impact on the environment should accompany the proposed action through the agency review process in order not to foreclose prematurely options which might have less detrimental effects.

EPA, Region X
Point (3) requires the responsible agency to study, develop and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources. Sufficient analysis of such alternatives and their costs and impact on the environment should accompany the proposed action through the agency review process in order not to foreclose prematurely options which might have less detrimental effects.

One should consider not only complete alternatives which might accomplish the objective with less impact, but also non-structural alternatives and those that include elimination of certain "high environmental impact"

aspects of the proposed action. Most actions involve a number of potential areas where an imaginative approach could lessen adverse environmental impacts while still meeting a majority of projected needs. An environmental statement should describe these alternatives in such a manner that reviewers can independently judge whether the environmental impacts result from a particular alternative or are inherent in the nature of the project.

. The last sentence of the CEQ and EPA guidelines for section (iii) is particularly important. For the first time, it is stipulated that an EIS requires sufficient analysis of alternatives so that independent evaluations of them may be made. Ideally, in order not to "foreclose prematurely options which might have less detrimental effects," subsection (iii) should precede (i) and (ii).

Sub-sections (iv) and (v) of 102(C) are specific, particularly important types of "probable impacts" and therefore also form a repetitive subset of sub-section (i). Before considering precise definitions and examples of these, let us consider a more appropriate structural outline for an EIS.

PROPOSED OUTLINE FOR EIS

The diagram in Figure 2 illustrates the organization suggested to provide a simpler, more useable, less repetitive impact statement. None of the elements required in section 102(C) are deleted, but they are restructured as indicated below in outline form:

I. Description of present conditions (CEQ, i)

II. Description of alternative actions (sec 102(C), iii)

- a. maintain status quo
- b. engineering alternatives
- c. design alternatives
- d. location alternatives
- e. institutional alternatives

III. Describe probable impacts of each alternative (sec 102(C), i) by relating the expected future conditions to present conditions.
   a. adverse (sec 102(C), ii)
   b. beneficial
   c. short versus long run (sec 102(C), iv)
   d. irreversible or irretrievable (sec 102(C), v)

IV. Identify the alternative chosen and indicate evaluation which led to choice.

V. Describe probable impacts of proposed action in detail.
   a. beneficial
   b. unavoidable adverse (sec 102(C), ii)

VI. Describe techniques to be used to minimize harm.

This outline can of course be developed to greater detail, but this generalized version makes clear the reorganization of the major elements.

The first consideration (I) is a discussion of present conditions. The description of present conditions essentially covers the same area as CEQ (i), except that it is not discussed solely in the light of the single proposed action. A statement of present conditions provides a general overview of the proposed project area, describing such specifics as the surrounding terrain and ecosystems, existing and proposed land use, and other existing environmental and cultural features. The present conditions should also indicate the need for the project's benefits. This should, therefore, also include a description of the project objective, as well as how the objective fits in with local, state, or federal plans, and with social, economic, and natural environmental goals.

Understanding present conditions, the reader is now ready to consider the potential actions or alternatives (II). One of the important options will be the alternative of maintaining the status quo (sometimes misleadingly called the "do-nothing" alternative). Engineering, design, location, operation, and institutional alternatives should also be considered. At this point the alternatives are merely established and

PROPOSED OUTLINE FOR EIS

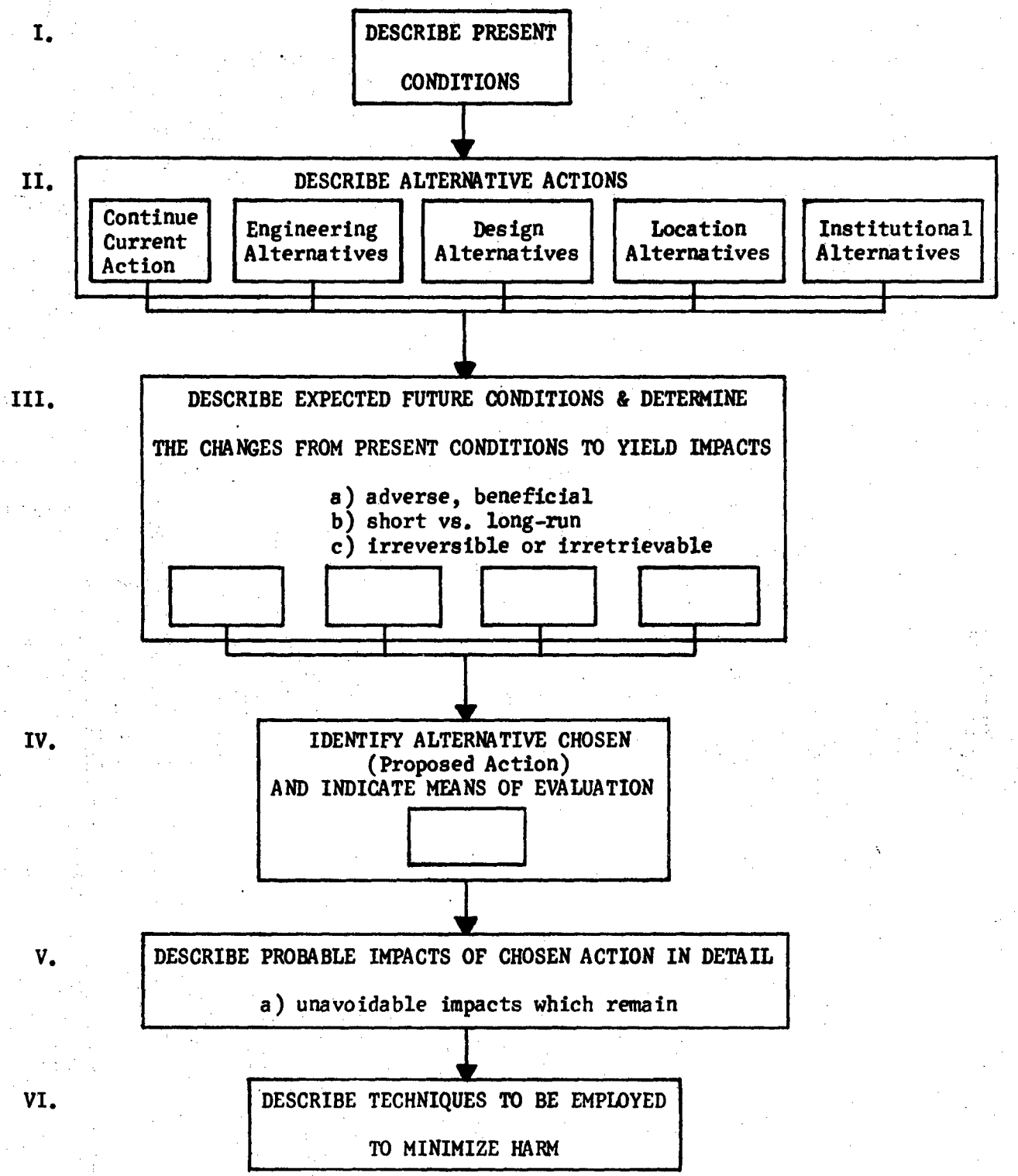
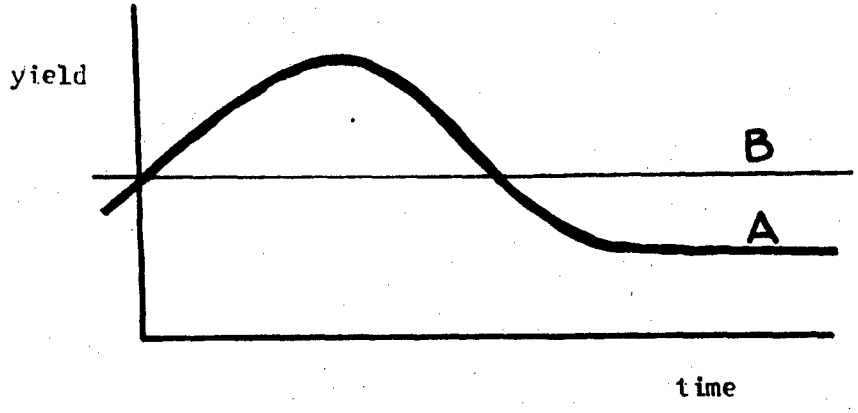


Figure 2 - Proposed outline for EIS

described; the analysis of their costs and impact is then carried out for all alternatives as the third component of the EIS. The previous definitions of this section (CEQ, iii) are therefore too broad for the present interpretation.

The next step (III) is to describe the future conditions resulting from each action so that differences among the resulting impacts can be identified. These descriptions should provide measurements of change which can serve as a suitable basis for evaluation and choice, but should not themselves be an evaluation. The importance of distinguishing between the description of changes which can be expected to occur and the evaluation of these changes is developed more fully in Chapter II. This step covers "probable impacts" as a general category including the specific crucial types identified in 102(C) (iv) and (v), and both adverse and beneficial. The definition of "probable impact" discussed previously is applicable here, for each alternative is treated as a proposed action.

Section (iv) of 102(C) requires an assessment of the relationship between "local short-term uses of man's environment and the maintenance and enhancement of the long-term productivity." According to the CEQ Guidelines "this in essence requires the agency to assess the action for cumulative and long-term effects from the perspective that each generation is trustee of the environment for succeeding generations." In effect, the proposing agency must show who is paying the environmental cost, the people who presently gain the benefits, or future generations who may only be left with the cost. This relationship is represented in the following diagram:



One must determine the value of maintaining productivity at a given level, B, for the long run, as opposed to the higher immediate yield but lower future yield to be gained from productivity at level A. As a concrete example, over-grazing now decreases maximum productivity of the range in the future. Similarly, building highways on agricultural land yields immediate ease of transportation for a car-oriented society, but decreases future agricultural lands available to a growing population. Most significant resource-based actions have a long-term effect since there is a foreclosure of choices for future generations. However, one should not simply restate the long-range impacts, but indicate specifically to what extent the actions taken now are decreasing the sustained yield-carrying capacity of environmental components.

Most environmental impact statements written to date assume that the "long-term" to be discussed is the life of the project. Evaluating productivity from the perspective that each generation is trustee of the environment for succeeding generations requires a much longer range view beyond the project life, including the effects of the demise of the project. The long-term extends until all effects of the project have disappeared.

Construction of a storage reservoir, for example, generally commits future generations to continue a similar use since the original condition cannot be restored within reasonable time or at reasonable cost. This reduction of future options should be considered.

Section (v) requires a description of any "irreversible and irretrievable commitment of resources." In most environmental impact statements, this section contains irrelevant or insignificant restatements of impacts. One should clarify the degree to which certain important results of the proposed action cannot be changed back in any feasible way. Once coal is burned there is no feasible way to recreate it for use for another purpose. This is an example of an irretrievable commitment. An irreversible commitment occurs, for example, when a child is born and provision

of schools is unavoidable beginning five years later. Irreversibility typically refers to actions, irretrievability to objects. One should not, however, split hairs over the definition of these terms since the importance of this unit lies in identifying the probability of environmental damage before it occurs and not in distinguishing irreversibility from irretrievability. Understanding the magnitude of what this section attempts to discover, one must realize that there will be projects where there are no significant irreversible or irretrievable commitments of resources.

Having determined the future conditions, one must now identify the alternative chosen. This proposed action is then discussed in further detail, following the proposed outline. One is now ready to consider section (ii) of 102(C), as to unavoidable adverse environmental effects. The previous definitions will still suffice, but unavoidability can now be defined with reference to the proposed alternative.

One must also indicate actions which will be taken to minimize harm resulting from the probable impacts of the proposed action. One should describe specific techniques, beyond those inherent in the project, which will be employed to minimize air pollution, water pollution, noise, disturbance of economic and social patterns, or visual pollution. This applies to the construction, operation, and eventual disposal of the facility.

SUMMARY DEFINITIONS FOR PROPOSED INTERPRETATION OF NEPA 102(C)

I. Describe present conditions

Requires a description of present conditions of the proposed project area, including specifics on surrounding terrain and ecosystems, existing and proposed land use, and other existing environmental and cultural features. A description of the project objective should be provided, including local, state, or federal plans, and social, economic, and natural environmental goals of the area in question. Information and data adequate to permit careful assessment of the project area by commenting agencies is necessary. Where relevant, maps and/or photographs should be provided.

II. Describe alternative actions

Requires the responsible agency to study, develop, and describe appropriate alternatives relevant to the proposed objective. Consideration should be given not only to engineering, design, location, institutional, and operation alternatives, but also to maintaining the status quo. Information and data adequate to permit careful assessment of the characteristics of each alternative by commenting agencies is necessary. Where relevant, maps and/or photographs should be provided.

III. Describe probable impacts of each alternative

Requires a description of primary and secondary impacts, including beneficial and detrimental impacts on aesthetic, socio-economic, and ecological systems. This section also requires a description of the environmental interrelationships in the direct project area and the total affected area.

In particular, long-range impacts are to be evaluated regarding the extent to which actions taken now are decreasing sustained yield or carrying capacity of environmental components. Actions which once made cannot be withdrawn or reversed must also be specifically highlighted.

IV. Identify alternative chosen and indicate evaluation which led to choice

Requires a statement of the action chosen to be proposed, including a more detailed development of its characteristics. The choice made

implies tradeoffs (see Chapter II) which must be considered both for their relative value implications and the relationship of these values to particular constituencies.

V. Describe probable impacts of proposed action in detail

Requires a more detailed description of the probable effects, both beneficial and adverse. In particular those adverse effects which will ensue even from this best alternative, and are therefore unavoidable in this context, should be highlighted. Evidence of compliance with local, state, and federal environmental control regulations should be provided.

VI. Describe techniques for minimizing harm

Requires a description of actions taken to minimize harm, including techniques employed to curb air pollution, water pollution, noise, disturbance of economic and social patterns, or visual pollution. This applies to both the construction and the operation of the facility.

II

ENVIRONMENTAL IMPACT ASSESSMENT METHODS: AN OVERVIEW

All of the elements which the National Environmental Policy Act requires for an Environmental Impact Statement--probable environmental impact, unavoidable adverse impacts, consideration of alternatives, local short term versus long run, and irreversible and irretrievable commitments--imply the need to be comprehensive. Ideally one wishes to consider all alternatives, and to identify all potential impacts. A major impetus for the act was the appearance of unexpected consequences of human actions. It is impossible to identify all impacts, but techniques can be employed which will help to assure a broader coverage. The need is essentially for a way of looking at the world without missing anything. This chapter briefly describes some promising approaches.

MULTIDISCIPLINARY TEAM

One approach, prescribed in NEPA, is the use of the interdisciplinary or, more precisely, multidisciplinary team. The basic assumption here is that a group of people with wide ranging expertise will in combination miss fewer effects than a group of people sharing a common background or training. It is most likely to be effective if the range of disciplines is chosen so as to cover all bases. Those that the proposer of a project thinks are irrelevant are precisely the ones most likely to turn up unexpected impacts. A checklist of areas of expertise involves all the problems inherent in checklists generally as will be discussed below, but a sample list is still worth including here:

Land
: Geography, Geology, Soils, Geomorphology, Land Resource Economics

Air
: Meteorology, Bioclimatology

Water
: Hydrology, Limnology

Plant
Botany, Forestry, Microbiology

Animal
Zoology, Wildlife

Man
Anthropology, Sociology, Medicine, Economics, Geography

This list is neither all inclusive, nor specific enough for any given project, but if one starts with this degree of generality, then these experts can determine whether more specialized expertise is necessary for a particular problem. Initially one is looking for broad based scientists able to discern legitimate questions and to direct them to people with specific expertise, who can provide at least approximate answers. A team of this type obviously needs a coordinator, and it is this person for whom this handbook is written. This coordinator should be a specialist in environmental impact assessment methods, team organization, and presentation of material for evaluation. To try to create a single type of person to carry out environmental impact analysis would be to contravene the effectiveness of the multidisciplinary team in achieving comprehensive analysis. The implications of this approach relative to the organization of the EIS review and preparation procedures within agencies should not be overlooked.

CHECKLISTS

A second major technique for achieving comprehensive analysis is the use of checklists. Here we concentrate on the desirable characteristics of a checklist and the appropriate ways of using such a list. Just as in the case of the multidisciplinary team, it is impossible to create, much less use, a complete, all inclusive checklist. Instead one employs a hierarchically structured list. In essence this entails an initial pass at impact identification at a very high level of generality--land, air, water, plants, animals, man. If no effects can be identified in a given general category, which must be determined by an implicit interpretation of the scope of that category, then the subcategories within that broad area are not pursued. If effects are noted, then the next

pass occurs at a more specific level- For example, under the category "land," bedrock geology, surface geology, soils, geomorphology, spatial location, and landscape aesthetics would be examined. The process is then repeated for successively more narrowly defined categories. At the ultimate levels of detail the items explored may be unique to the individual project and therefore not part of any prepared or published list.

The hierarchically structured list is one of the few ways available to man to consider a long list of items. It relies on an internal memory, implied by the definition of the general category, of what types of things should be considered in that category, and an external memory, the checklist, which provides reminders at each successive, more specific level.

Hierarchically structured lists should be used by people who can be expected to have a fairly good implicit, internal memory of possible effects in a given general category. This requires a progression of increasingly specialized scientists. In many cases, however, EIS writers and reviewers will be involved with a large number of similar types of projects, perhaps in similar areas of the state. In these cases where repetition is frequent, checklists can be structured for specific types of problems or regions. Experience will also aid in pruning the comprehensive checklist so as to make repeated application easier. This can, of course, lead to the trap of a fixed search of the list, not sufficiently open-ended to be applied in different physiographic or socioeconomic circumstances, even for identical projects. One must be alert to this possibility.

A second use of the checklist requires that it be a tangible document rather than an intangible thought process. Often an EIS will give no indication whether a specific impact was considered or not. Unfortunately, the reviewer cannot simply assume that impacts not identified in the report are not expected to occur. In order to do this he must be able to determine not only what impacts were considered and deemed likely to occur, but also which impacts were considered but deemed unlikely to occur. If he has a copy of the checklist to some reasonable level of specificity he can identify all the things that were considered but by implication not expected to occur, and thus need not ask "Was this considered?" in his comments.

There are two separate types of checklists which can be developed. One outlines the components or attributes of the project or action proposed, and the second outlines the indicators of effects on environmental factors. In structuring the elements of a project one might divide it into design phase, construction phase, operation phase, and disposal phase. Within each of these, particular actions would be indicated such as clearing of vegetation, removal of topsoil, excavation, provision of access, etc.

Lists of indicators of environmental effects, in essence identifying a set of criteria of environmental change against which projects should be measured, can be structured in several ways. Examples 1 and 2 on the following pages each divide environmental effects or impacts into categories in different ways. In some cases conditions which might be affected are listed, but it is difficult to interpret them in terms of degree of impact or change. For example, "Soil suitability for use" in Example 1 is not an index of impact, unless one interprets this to mean that carrying out a project will change the soil suitability. Suitability and impact must not be confused. An impact checklist must identify criteria along which change resulting from a proposed project can be indicated. In Example 1, for instance, "turbidity" listed under the heading "water" can be investigated to see whether levels of turbidity will change. This need not imply that it would be easy to measure. For example, although psychological health would be difficult to measure, one can at least understand what might be meant by a change in psychological health resulting from a project, and could therefore make some rough estimate of the impact.

EXAMPLE 1

Table 1. Assessment Parameters

PHYSICAL/CHEMICAL

Water

- .BOD
- .Groundwater Flow
- .Dissolved Oxygen
- .Fecal Coliforms
- .Inorganic Carbon
- .Inorganic Nitrogen
- .Inorganic Phosphate
- .Heavy Metals
- .Pesticides
- .Petrochemicals
- .pH
- .Stream Flow
- .Temperature
- .Total Dissolved Solids
- .Toxic Substances
- .Turbidity

Noise

- .Intensity
- .Duration
- .Frequency

Land

- .Soil Erosion
- .Flood Plain Usage
- .Buffer Zones
- .Soil Suitability for Use
- .Compatibility of Land Uses
- .Solid Waste Disposal

Air

- .Carbon Monoxide
- .Hydrocarbons
- .Nitrogen Oxides
- .Particulate Matter
- .Photochemical Oxidants
- .Sulfur Oxides
- .Methane
- .Hydrogen and Organic Sulfides
- .Other

ECOLOGICAL

Species and Populations

- .Game and Nongame Animals
- .Natural Vegetation
- .Managed Vegetation
- .Resident and Migratory Birds
- .Sport and Commercial Fisheries
- .Pest Species

Habitats and Communities

- .Species Diversity
- .Rare and Endangered Species
- .Food Chain Index

Ecosystems

- .Productivity
- .Biogeochemical Cycling
- .Energy Flow

AESTHETIC

Land

- .Geologic Surface Material
- .Relief and Topography

Air

- .Odor
- .Visual
- .Sounds

Water

- .Flow
- .Clarity
- .Interface Land and Water
- .Floating Materials

Biota

- .Animals--Wild and Domestic
- .Vegetation Type
- .Vegetation Diversity

Man-Made Objects

- .Man-Made Objects
- .Consonance with Environment

Composition

- .Composite Effect
- .Unique Composition
- .Mood Atmosphere

SOCIAL

Individual Environmental Interests

- .Educational/Scientific
- .Cultural
- .Historical
- .Leisure/Recreation

Social Interactions

- .Political
- .Socialization
- .Religious
- .Family
- .Economic

Individual Well-Being

- .Physiological Health
- .Psychological Health
- .Safety
- .Hygenic

Community Well-Being

- .Community Well-Being

Source: Environmental Assessments for Effective Water Quality Management And Planning, E.P.A., Washington, D.C., April, 1972, p. 21.

EXAMPLE 2

Table 1

POTENTIAL ENVIRONMENTAL IMPACTS OF A TRANSPORTATION PROJECT
(by category of impact and the significance of major ones at various stages of the project)

Category	Potential Significance[1] at Stage of: Planning and Design	Construction	Operation
1. Noise Impacts		x	x
a. Public Health			
b. Land Use			
2. Air Quality Impacts		x	x
a. Public Health			
b. Land Use			
3. Water Quality Impacts		x	x
a. Ground Water			
(1) Flow and water table alteration			
(2) Interaction with surface drainage			
b. Surface Water			
(1) Shoreline and bottom alteration			
(2) Effects of filling and dredging			
(3) Drainage and flood characteristics			
c. Quality aspects			
(1) Effect of effluent loadings			
(2) Implications of other actions such as			
-disturbance of benthic layers			
-alteration of currents			
-changes in flow regime			
-saline intrusion in ground water			
(3) Land Use			
(4) Public Health			

Category	Planning and Design	Construction	Operation
4. Soil Erosion Impacts		x	x
a. Economic and Land Use b. Pollution and Siltation			
5. Ecologic Impacts		x	x
a. Flora b. Fauna (other than man)			
6. Economic Impacts			
a. Land Use (1) In immediate area of project (2) In local jurisdiction served or traversed (3) In region	x	x	x
b. Tax Base (1) Loss through displacements (2) Gain through increased values	x	x	x
c. Employment (1) Access to existing opportunities (2) Creation of new jobs (3) Displacement from jobs	x	x	x
d. Housing and Public Services (1) Demand for new services (2) Alteration in existing services	x	x	x
e. Income	x	x	x
f. Damage to economically valuable natural resources		x	x

Category	Planning and Design	Construction	Operation
7. Socio-Political Impacts			
a. Damage to, or use of,		x	x
(1) Cultural resources (2) Scientific resources (3) Historic resources (4) Recreation areas			
b. Life styles and activities	x	x	x
(1) Increased mobility (2) Disruption of community			
c. Perception of cost/benefit by different cohesive groups	x	x	x
(1) Racial (2) Ethnic (3) Income class			
d. Personal Safety		x	x
8. Aesthetic and Visual Impacts		x	x
a. Scenic resources b. Urban design c. Noise d. Air Quality e. Water Quality			

[1] "x" denotes an impact which could be positive as well as negative, depending on circumstances.

Source: Department of Transportation, Synthesis for Action, Washington, D.C., April, 1971, p. 25.

ENVIRONMENTAL ASSESSMENT TABLES AND MATRICES

A frequent extension of the checklist is the environmental impact assessment matrix, wherein each proposed action (or its separate components) is identified as a column of a table or matrix, and the impacts, in the form of various indexes of change in the environment, are identified by reference to rows of the matrix. This serves to combine the checklist of the project elements with the checklist of impacts.

An environmental impact matrix, such as that suggested by Leopold in U.S. Geological Survey Circular 645, should not be confused with a land suitability rating matrix, such as in the work of Ian McHarg. In a land suitability rating table, the rows describe current conditions of the environment at a particular place. The table is filled in with information indicating the relative merit of locating the use or project listed for that column on the region or land characteristic listed for that row. The evaluator must consider all types of impacts and costs which will vary due to the particular site conditions. Thus one effect of locating a parking lot on currently poorly drained soils may be to increase flood peaks in a nearby stream. The effect is not on the soil, but the effect varies in degree with respect to variation in soil characteristics among sites where the parking lot might be located. Thus the land suitability table provides information about the variation of impacts and costs due to the variations in the characteristics of land.

An environmental impact table is quite different. The general form is illustrated in Figure 3. The columns still list land uses, proposed projects, or components of projects, but the rows do not represent conditions occurring at various sites. Rather they represent indicators or indices of environmental change; they indicate types of impacts. The best known example of an impact table is that referred to earlier by Luna Leopold. Experience has shown that confusion arises in using this table. Is it to be filled in relative to impacts or relative to site conditions? For example, for a given project component, the row for "Land Use: Forestry" should not be filled in with a rating indicating

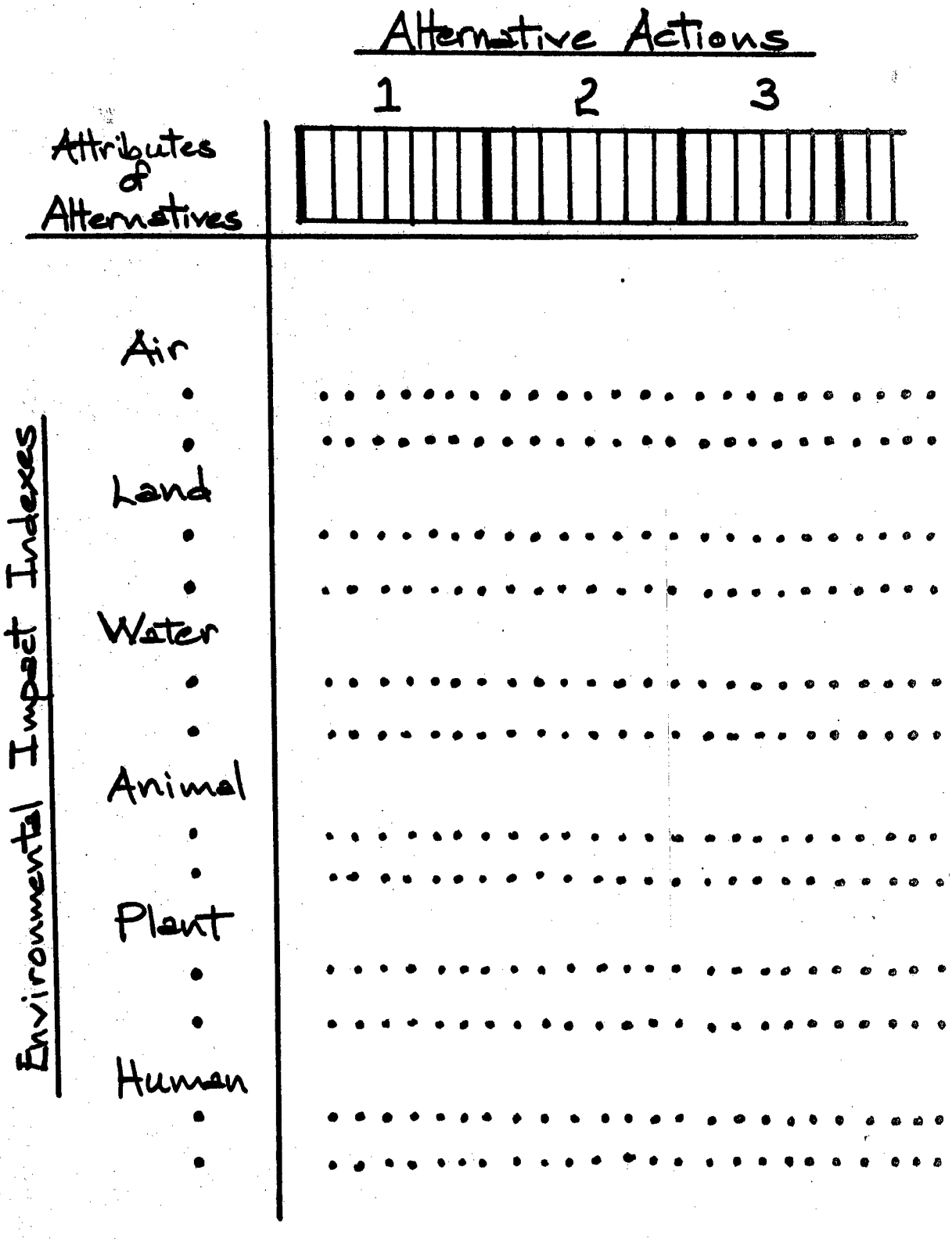


Figure 3 - Environmental Impact Table

the suitability of forested land for the project under consideration, but rather with the impact on forestry everywhere, if the project is carried out. One must make this judgment on the basis of all the characteristics of the site proposed for the action relative to the particular environmental effect. For example, if a parking lot is under consideration and it is to be located on a poorly drained soil area near a river, without artificial water holding facilities, then an impact should be recorded in the row for flooding in the impact table. This rating has nothing to do directly with the effect of floods on the parking lot, but only with the impact of the parking lot on floods.

The two types of tables just described, suitability and impact, can now be seen to be complementary. Each in effect assumes the existence of the other. The land suitability rating table relates a proposed action to the characteristics of sites on which it might be located, indicating a rating accounting for all impacts or costs which vary with respect to each factor of site quality. The impacts table indicates the impact which occurs in terms of a change in indicators of environmental quality, based on all characteristics of the site on which the activity is located. The information of both tables can be represented in a three dimensional framework as shown in Figure 4, but this form is not particularly useful for recording information. A set of two dimensional tables would be more useful. This would include either a set of impact tables, one for each type of site, or a set of suitability tables, one for each impact.

In "A Framework for Identification and Control of Resource Degradation..." Sorensen has proposed a "stepped matrix" and impact network as an alternative format for an impact table, as illustrated in Figure 5. The network, actually a tree in form, is used to relate and record secondary and tertiary effects and initial impacts and actions. The "stepped matrix" eliminates redundancy, which would make a much larger tree, by identifying project components common to several actions and impacts common to several project components. One could continue this format for the secondary effects common to several initial impacts, and so on.

It is apparent that cycles of effects may repeat in the expansion of the tree of impacts. This cannot be ignored or simply eliminated. Such

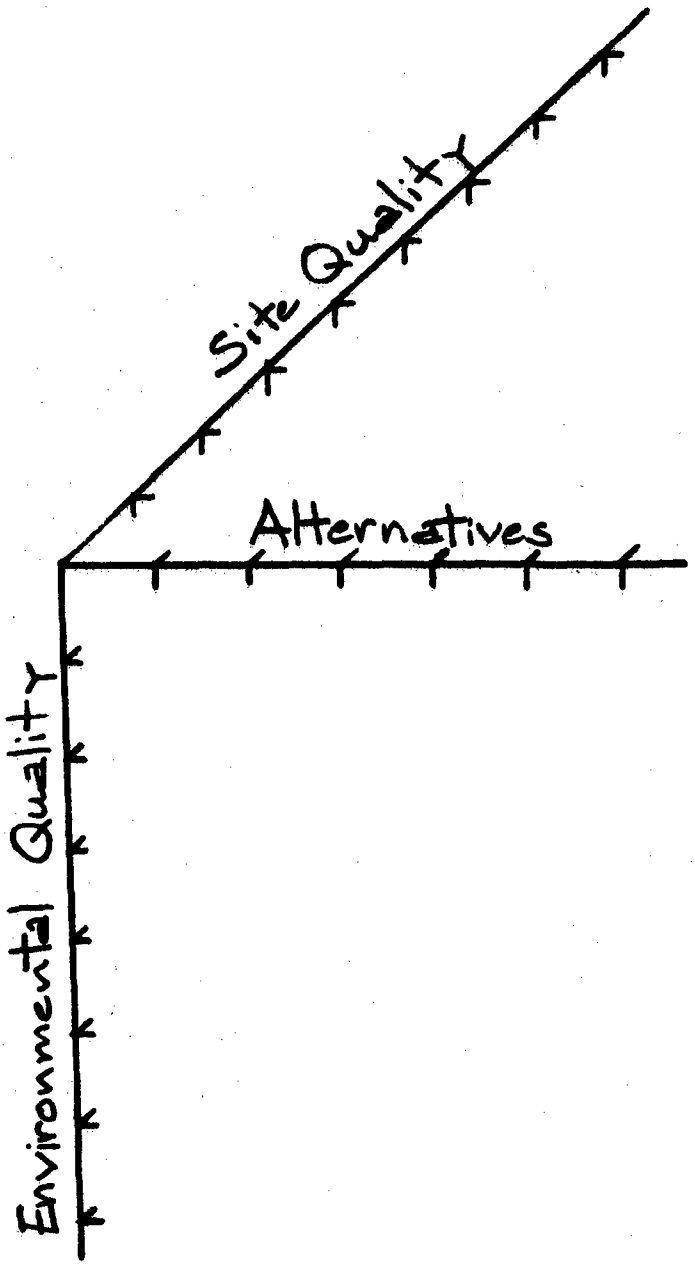


Figure 4 - Combined Impact and Suitability Table

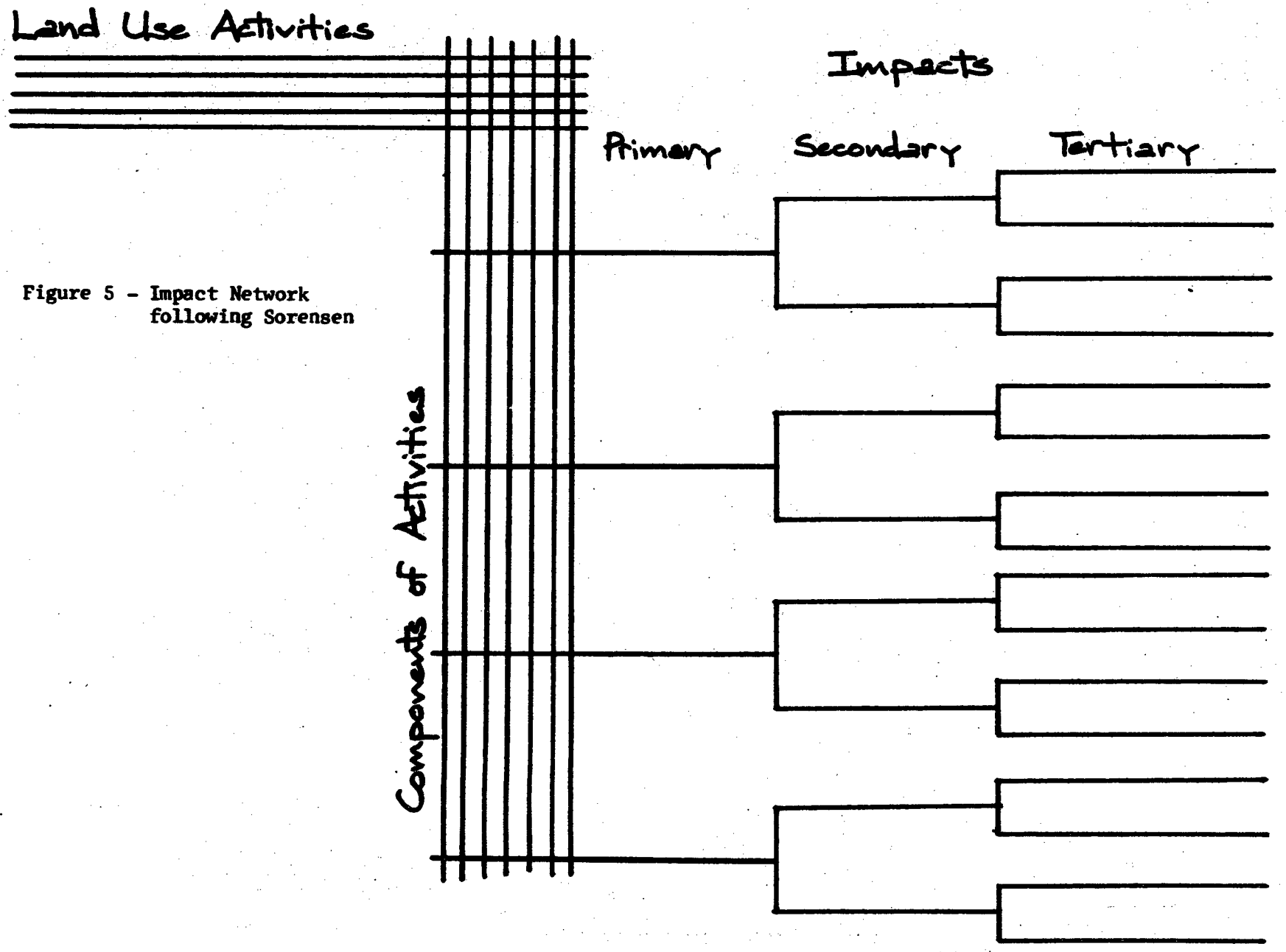


Figure 5 - Impact Network following Sorensen

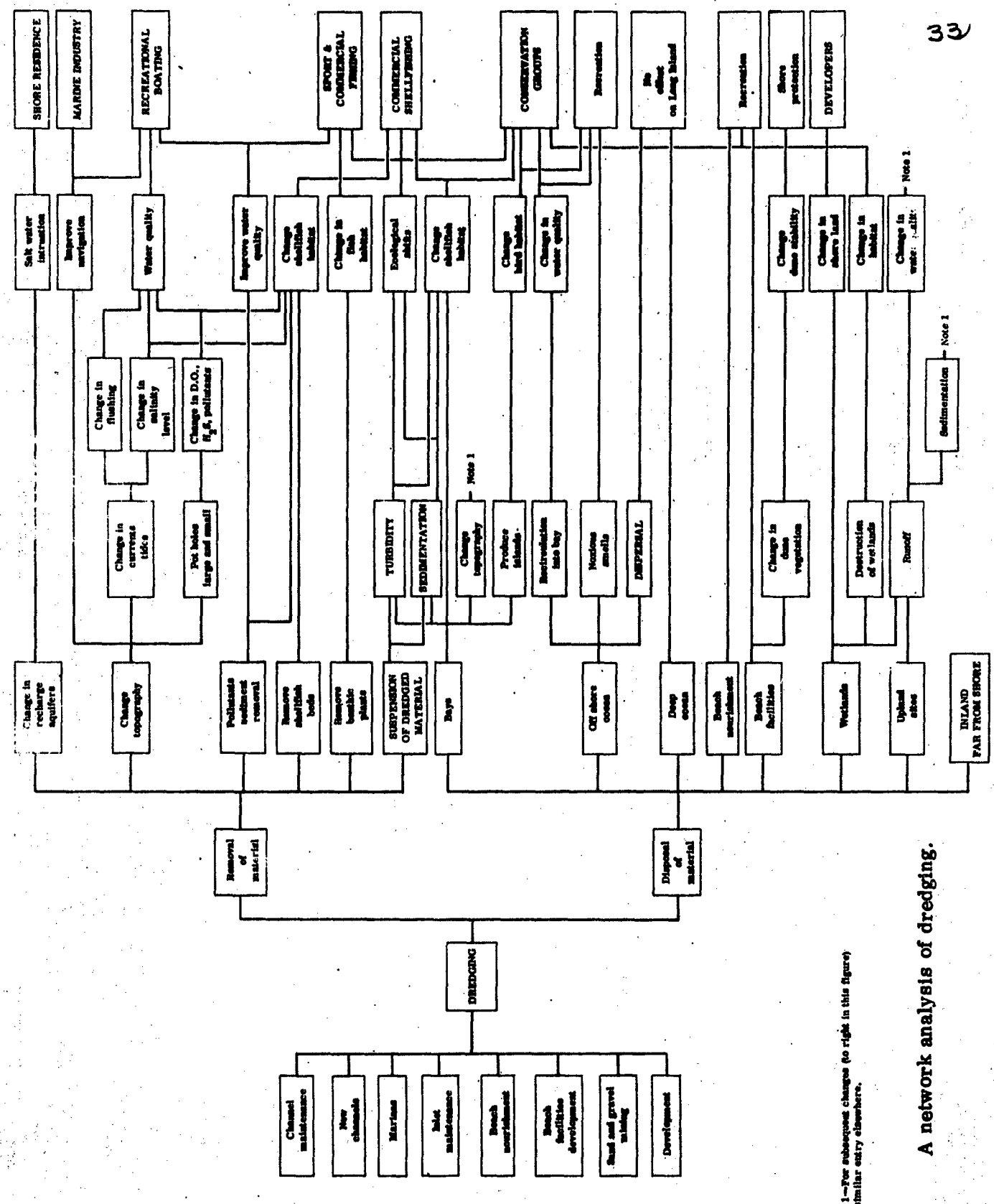
cycles may be indicative of absorption or amplification of the impact by the natural system. The basis for evaluation of impact, at least in terms of the National Environmental Policy Act, is in terms of impact on the human environment. One therefore needs to know whether an evaluation only on the basis of a secondary or tertiary effect will be amplified or absorbed before its effects on the human environment occur. Evaluation at any degree of expansion of the tree implies knowledge of the remainder of the tree, and of many cycles forced into that tree structure.

Examples 3, 4, and 5 illustrate other formats for presenting primary and secondary effects. The first is similar to Sorensen's in identifying a set of project elements, all of which include a single act, dredging, which can then be expanded as a network of primary and secondary effects. In this case the incidence of the human impact is also identified. The last two examples provide similar information but in outline form, permitting more complete verbal descriptions and interpretations.

A neat structure for recording impacts does not eliminate the tremendous difficulties of actually determining what they are. Even if one develops both suitability and impact tables, combining the characteristics of the place with the impacts on environmental indices, the spatial picture is still not complete. Impacts depend not only on the characteristics of the location at which the instigating activity occurs, but also on the characteristics of the place at which the impact is recorded, and of places in between. The spatial pattern of effects depends on the medium (air, water, food, etc.) by which the effect is transported.

MEASUREMENT OF IMPACTS AND EVALUATION

The matrix methods described in the previous section and the need for tables presenting comparisons of alternatives both require some kind of statement as to what the impact on the particular environmental indicator is, given a specific action. This requires some kind of measurement in the most general sense. First we consider the problem of measuring the impact itself, what Leopold has called magnitude, and second the problem of evaluating that level of impact in terms of its relative value to



A network analysis of dredging.

Note 1—For subsequent changes (to right in this figure) see similar entry elsewhere.

EXAMPLE 3

FROM: The Design of a Management Information System for Coastal Resources Planning, The Center for Man and Environment, 1972

EXAMPLE 4

RELATIONSHIP BETWEEN HOUSING DEVELOPMENT AND UNDERLYING EARTH CONDITIONS, SITE VEGETATION CONDITIONS

Plans, Policies	Condition changed	Agencies or groups with designated authority or expertise.	
G-2	irrigation septic tank seepage cut and fill loading of slope with structures → Stimulation of landslides, slumps on public roads, rupturing of public service pipes and cables. .Cost of repair or maintenance.	USGS	DMG
G-2	→ Siting of structure and roads on unstable slopes-prone to landslides. .Disaster relief. Public hazard.	USGS	DMG
G-2	→ Siting of structures under slopes prone to landsliding, mudsliding. .Public hazard. Disaster relief.	USGS	DMG
G-2	→ Siting of structures and roads on cliffs or dunes that are actively eroding. .Necessitate cliff stabilization. .Reduce amount of naturally eroding material carried into the coast's littoral system-beach erosion, stimulate or increase cliff erosion. .Unattractive structural modifications visible from public recreation areas or scenic highways. .Imperil cliff edge development, repair of public services-blighted conditions of abandoned structures, public demolition.	USGS,CE	DMG, DNOD

G-2	→ Siting of structures on historically active fault zones, areas of high seismic shake potential, liquifaction potential.	USGS	DMG
	.Public hazard. Disaster relief, repair of public services.		
	→ Increase forest or brush fire hazard by suppression of fire in those vegetation types where fire is a naturally reoccurring factor.		DF, LFD
	.Cost of fire suppression and control. .Disaster relief.		
	[landscaping]		
	→ Introduction of vegetation which will spread onto adjoining lands.	DA	ASA
	.Weed control on grazing and croplands. .Degrade quality of indigenous vegetation communities for educational, scientific, and recreational use.		

Source: Sorensen, Jens, & James Pepper, Procedure for Regional Clearinghouse Review of Environmental Impact Statements, prepared for Association of Bay Area Governments, (San Francisco), May, 1972.

Table 2–GUIDANCE FOR DESCRIPTION OF ENVIRONMENTAL EFFECTS–Continued

Primary Impact	Population or Resources Affected	Description	Unit of Measure[1]	Method of Computation
4. Land				
4.1 Site selection	4.1.1 Land, amount	Land will be preempted for construction of nuclear power plant, plant facilities, and exclusion zone.	Acres.	State number of acres preempted for plant, exclusion zone, and accessory facilities such as cooling towers and ponds. By separate schedule state the type and class of land preempted (e.g., scenic shoreline, wet land, forest land, etc.).
4.2 Construction activities (including site preparation)	4.2.1 People (amenities)	There will be a loss of desirable qualities in the environment due to the noise and movement of men, material and machines.	Number by category, years.	The disruption of community life (or alternatively the degree of community isolation from such irritations, should be estimated. Estimate the number of residences, schools, hospitals, etc., within area of visual and audio impacts. Estimate the duration of impacts.
	4.2.2 People (accessibility of historical sites)	Historical sites may be affected by construction	Visitors per year.	Determine historical sites that might be displaced by generation facilities. Estimate effect on any other sites in plant environs. Express net impact in terms of annual number of visitors.
	4.2.3 People (accessibility of archeological sites)	Construction activity may impinge upon sites of archaeological value.	Qualified opinion.	Summarize evaluation of impact on archeological resources in terms of remaining potential value of the site. Referenced documentation should include statements from responsible county, State or Federal agencies, if available.
	4.2.4 Wildlife	Wildlife may be affected.	Qualified opinion.	Summarize qualified opinion including views of cognizant local and State wildlife agencies when available, taking into account both beneficial and adverse affects.
	4.2.5 Land (erosion)	Site preparation and plant construction will involve cut and fill operations with accompanying erosion potential.	Cubic yards and acres.	Estimate soil displaced by construction activity and erosion. Beneficial and detrimental effects should be reported separately.
4.3 Plant operation	4.3.1 People (amenities)	Noise may induce stress.	Number of residents, school populations, hospital beds.	Use the Proposed HUD Criterion Guideline for Non-Aircraft Noise to establish areas receiving noise in the categories of "Clearly Unacceptable," "Normally Unacceptable" and "Normally Acceptable." For each area report separately the number of residences, the total school population, and the total number of hospital beds.
	4.3.2 People (aesthetics)	The local landscape as viewed from adjacent residential areas and neighboring historical, scenic, and recreational sites may be rendered	Qualified opinion.	Summarize qualified opinion including views of cognizant local and regional authorities when available.

[1] Applicant may substitute an alternative unit of measure, where appropriate. Such a measure should be applied consistently to all alternatives for the effect being measured.

Table 2--GUIDANCE FOR DESCRIPTION OF ENVIRONMENTAL EFFECTS--Continued

Primary Impact	Population or Resources Affected	Description	Unit of Measure[1]	Method of Computation
4. Land				
4.1 Site selection	4.1.1 Land, amount	Land will be preempted for construction of nuclear power plant, plant facilities, and exclusion zone.	Acres.	State number of acres preempted for plant, exclusion zone, and accessory facilities such as cooling towers and ponds. By separate schedule state the type and class of land preempted (e.g., scenic shoreline, wet land, forest land, etc.).
4.2 Construction activities (including site preparation)	4.2.1 People (amenities)	There will be a loss of desirable qualities in the environment due to the noise and movement of men, material and machines.	Number by category, years.	The disruption of community life (or alternatively the degree of community isolation from such irritations, should be estimated. Estimate the number of residences, schools, hospitals, etc., within area of visual and audio impacts. Estimate the duration of impacts.
	4.2.2 People (accessibility of historical sites)	Historical sites may be affected by construction	Visitors per year.	Determine historical sites that might be displaced by generation facilities. Estimate effect on any other sites in plant environs. Express net impact in terms of annual number of visitors.
	4.2.3 People (accessibility of archeological sites)	Construction activity may impinge upon sites of archaeological value.	Qualified opinion.	Summarize evaluation of impact on archeological resources in terms of remaining potential value of the site. Referenced documentation should include statements from responsible county, State or Federal agencies, if available.
	4.2.4 Wildlife	Wildlife may be affected.	Qualified opinion.	Summarize qualified opinion including views of cognizant local and State wildlife agencies when available, taking into account both beneficial and adverse affects.
	4.2.5 Land (erosion)	Site preparation and plant construction will involve cut and fill operations with accompanying erosion potential.	Cubic yards and acres.	Estimate soil displaced by construction activity and erosion. Beneficial and detrimental effects should be reported separately.
4.3 Plant operation	4.3.1 People (amenities)	Noise may induce stress.	Number of residents, school populations, hospital beds.	Use the Proposed HUD Criterion Guideline for Non-Aircraft Noise to establish areas receiving noise in the categories of "Clearly Unacceptable," "Normally Unacceptable" and "Normally Acceptable." For each area report separately the number of residences, the total school population, and the total number of hospital beds.
	4.3.2 People (aesthetics)	The local landscape as viewed from adjacent residential areas and neighboring historical, scenic, and recreational sites may be rendered	Qualified opinion.	Summarize qualified opinion including views of cognizant local and regional authorities when available.

[1] Applicant may substitute an alternative unit of measure, where appropriate. Such a measure should be applied consistently to all alternatives for the effect being measured.

EXAMPLE 5

Table 2—GUIDANCE FOR DESCRIPTION OF ENVIRONMENTAL EFFECTS—Continued

Primary Impact	Population or Resources Affected	Description	Unit of Measure[1]	Method of Computation
4.6 Transmission facilities construction	4.6.1 Land adjacent to right-of-way	Constructing new roads for access to right-of-way may have environmental impact.	Miles.	Estimate length of new access and service roads required for alternative routes.
	4.6.2 Land, erosion	Soil erosion may result from construction activities.	Tons per year.	Estimate area with increased erosion potential traceable to construction activities.
	4.6.3 Wildlife	Wildlife may be affected.	Qualified opinion.	
4.7 Transmission line operation	4.7.1 Land Use	Land preempted by right-of-way may be used for additional beneficial purposes such as orchards, picnic areas, nurseries, hiking and riding trails.	%	Estimate percent of right-of-way for which no multiple use activities are planned.
	4.7.2 Wildlife	Modified wildlife habitat may result in changes.	Qualified opinion.	Summarize qualified opinion including views of cognizant local and State wildlife agencies when available.
4.8 Other land impacts				The applicant should describe and quantify any other environmental effects of the proposed plant which are significant.
4.9 Combined or interactive effects				Where evidence indicates that the combined effects of a number of impacts on a particular population or resource are not adequately indicated by measures of the separate impacts, the total combined effect should be described.
4.10 Net effects				See discussion in Section 5.8.

[1] Applicant may substitute an alternative unit of measure, where appropriate. Such a measure should be applied consistently to all alternatives for the effect being measured.

the appropriate constituency. This distinction is important. In the first case one is looking for data about changes in the environment, and must rely on scientific knowledge. This may of course yield only approximate answers, but these will be based on expert judgment. In the second case one is looking for the relative values of the society or segments of society concerned in the evaluation of a project. This is inherently "value judgment" and cannot be based on scientific research into environmental systems. One may, however, survey constituencies to attempt to determine the preferences of affected groups.

Measurement of Impact

In order to identify the possible ways of expressing impacts it is appropriate to consider the various possible types of measurement--nominal, ordinal, interval, and ratio--and the information each provides. At the most basic level, and a prerequisite to all others, is nominal measurement. This is simply the naming of elements, which implies the not necessarily trivial ability to distinguish like from unlike elements. In order to indicate that some amount of farm land will be taken for a new highway, one must be able to distinguish farm land from other kinds of land.

One would like, however, to have some notion of the amount of impact. An ordinal scale ranks different events according to some criterion: a strip of interstate highway leads to greater air pollution per passenger mile than a strip of railroad track. There is no indication of how much more, but there is an ordering. Any number of actions could be ordered in this fashion, leading to a set of actions ranked by level of pollution. Remember, this does not necessarily have any value implications. One is stating only that some acts lead to a higher level of air pollution than others.

Still better, one would like to know how much more air pollution occurs with one action versus another. This can be given by an interval scale, which indicates this difference in some arbitrary unit appropriate to the particular criterion, for example, air temperature. One can state that a particular action leads to some number of units more pollution than

another. One can deal only in differences between levels, not ratios, since the zero level is not meaningfully defined.

Finally, a ratio scale relies on an arbitrary unit of difference, but a fixed, meaningful zero. For example, if one action consumes 10 units of farm land and another consumes 5, it is relevant to use the ratio and say that one consumes twice as much as the other.

It would be pointless to indulge in this discussion of levels of measurement if most indicators of environmental change could be expressed as ratio numbers. This may seem likely since the existing condition could be taken as zero and the positive or negative changes expressed as ratios of change. However, the complexity of measuring aggregate environmental quality indicators such as air pollution renders this impractical. One must deal with an entire set of pollutants for which no common denominator exists. Therefore one typically constructs interval or ordinal indices of degrees of environmental change.

At the extreme one may only be able to say that something will happen to a given indicator of environmental change, but not what. A matrix may thus consist of statements both verbal and numerical, at various levels of measurement. This is a presentation of the information as it is, be it best professional judgment that something will probably happen, or a very precise ratio number estimate of the expected level, with a plus or minus error range. Thus the structure of an impact matrix, the statement writer, and the statement reviewer must be able to deal with a wide range of levels of measurement. The checklist in Example 5 provides an excellent framework by specifying not only the unit of measure for each impact, but also the manner in which this measurement is to be obtained. Note particularly those elements where the impact can only be gauged by "qualified opinion."

Evaluation

The above described statements of magnitude or degree of impact constitute the core of the impact matrix or statement. They should be presented in this raw form for others to consider. In order to choose a project from the set of alternatives, which the final impact statement

implies has been done, one must evaluate the various alternatives in terms of the degree of impact on the whole set of environmental indicators. This evaluation is in essence the assigning of relative values to various amounts of change in environmental quality for various factors. This transformation of impact levels into values must be based on the values held, either explicitly or implicitly, by some constituency. There is no way to avoid this. When a choice is made among alternatives, the relative values for each of the factors are implicitly determined to a degree at least sufficient to have lead to that decision. It is therefore worth considering the implied values as checks on a previous intuitive decision, even if one does not make explicit statements of value in order to come to a decision.

The following example illustrates the implicit assignment of relative values to two impact criteria in a simplified choice situation.

		Project Alternatives (e.g., alternative highway corridors)				
		A	B	C	D	E
Measures of Impact	# of dwelling units displaced	16	5	12	4	6
	# of units of farm land displaced	20	8	6	10	7

Five alternatives, which could be alternative highway corridors for example, are presented with degrees of impact measured on two separate scales as indicated in the table. The choice requires some statement of the relative values of units on the two scales, which in this case are number of dwelling units displaced and number of units of farm land displaced. If action B were chosen, a unit of farm land is implied to be worth less than one dwelling unit, since the decision maker preferred to forego action E where he could have accepted an additional displaced

dwelling unit in order to reduce by one unit the farm land consumed. A unit of farm land is worth more than ½ dwelling unit since otherwise action D would be preferred to B. Therefore, the unit of farm land is worth between ½ and 1 dwelling unit. Similar implied approximate valuations can be derived for other choices. These implied values only hold for the margin, that is, for the particular choice at a particular level on the two scales, but they can serve as checks on decisions. It is appropriate to ask someone who has made such a choice (including oneself) if the implied valuation is acceptable. Is that exchange one I would be willing to make? This further emphasizes the importance of presenting magnitude or degree of impact measures explicitly in an impact statement. It permits the external evaluator to ascertain the value implications of the choices made, and to experiment with his <u>own</u> value choices.

The second approach, more direct, but more greedy of commitment and judgment, is to explicitly identify a transformation of the degree of impact scale to a value scale and to then transform each value scale for the separate environmental indicators into a composite value score. Some simple graphics illustrate the process and may also be useful in carrying it out. In Figure 6 two scales, the units of farm land and its value in the given context, define the axes. The line shows the transformation function. For any number of units of farm land displaced, one can find the relative value by drawing a vertical line from the level in units of farm land to the transformation function and then a horizontal line from this intersection to the vertical axis. The value scale can be based on any arbitrary unit of measure, though the unit chosen will affect the slope of the transformation line. Figure 6a illustrates a linear relationship where value decreases as number of units of farm land displaced increases. Figure 6b illustrates a nonlinear value transformation function where small displacements have little effect, but as more and more farm land is displaced the remainder becomes more valuable, and therefore its displacement causes a greater decrease in value.

One can make similar transformations for each of the other measures of impact. These value judgments still apply only to the individual environmental indicators. One could at this point make intuitive choices

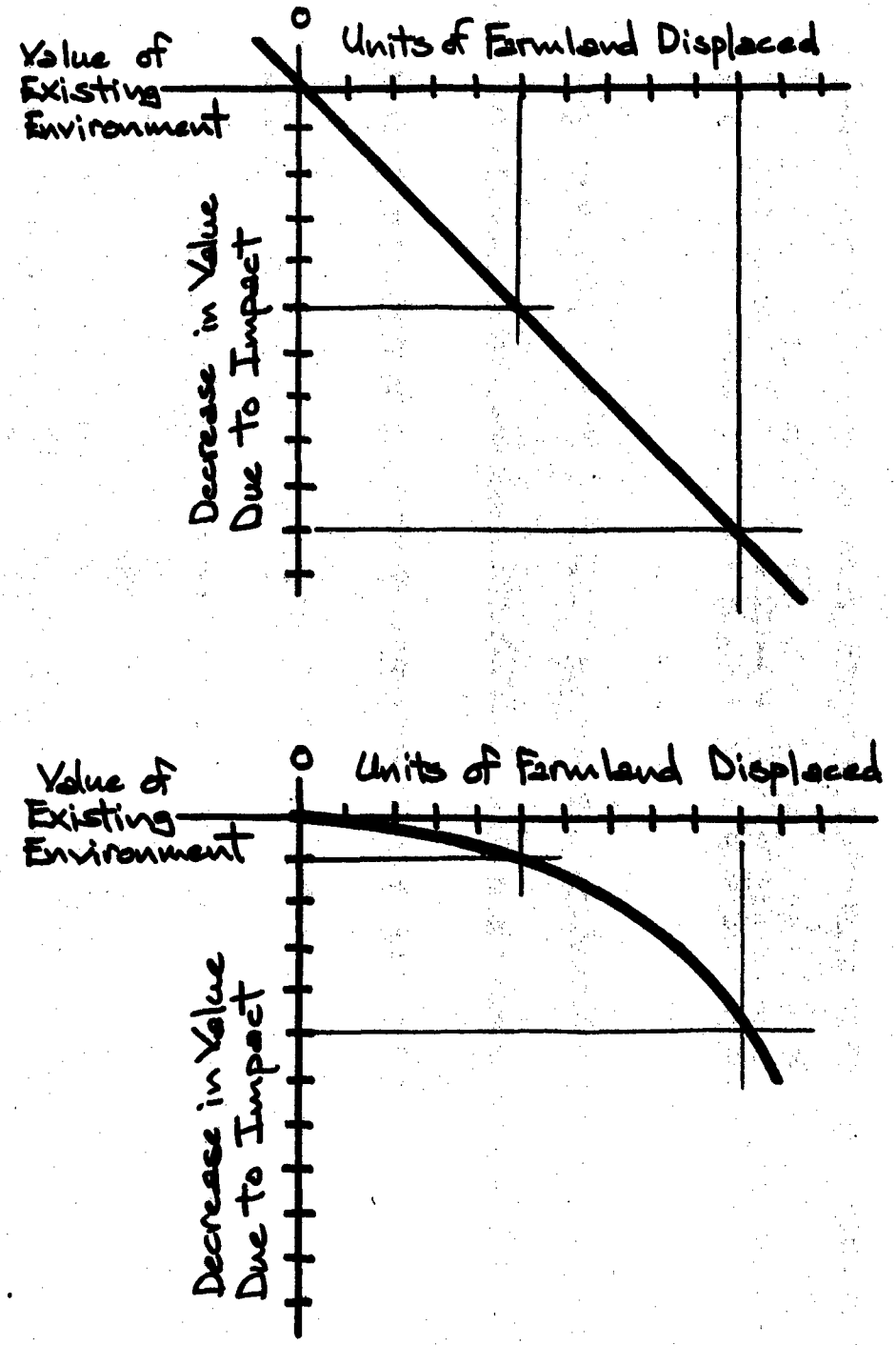


Figure 6 - Transformation of Level of Impact to Value

among value levels as previously described for the impact level scales. These would similarly imply relative values at the margin for the various environmental value scales. In effect one would be indicating the ratio between units of measure on one value scale to units of measure on another, since each scale is arbitrary. The alternative is to repeat the transformation process just described, transforming each of the individual value scales into a value scale with a common, but still arbitrary unit of value. Since the value scales are interval scales, and the composite scale need not have anything to do with money units, no direct cost benefit ratio can be ascribed. Net differences in relative value between alternatives can be identified and used as explicit criteria along with capital costs and other factors (there are always other factors) external to this analysis.

In summary, one should first provide a tabular or matrix presentation of degrees of environmental change for the various alternatives and projects using whatever level of measurement is possible. Second, one should indicate either implicitly or explicitly the evaluation of these which lead to the proposed solution.

When presented in this form, the tabular summaries can be 1) the basis for the writing of an impact statement (the primary purpose visualized by Leopold for the matrix he proposed), 2) a comparison of alternatives, 3) a framework for evaluation, and 4) the basis for evaluation by others.

III

ANNOTATED EXAMPLES

OF

IMPACT STATEMENT ELEMENTS

INTRODUCTION

The major purpose of this chapter is to analyze examples of specific Environmental Impact Statement elements, indicating how improvements could be made and distinguishing good content and presentation from bad. It thus also provides examples for novice statement writers to emulate or avoid. The commentary here should not be construed as favoring any particular project cited, but rather as a response to the adequacy of particular parts of the EIS, and the manner in which they were constructed.

The first section of this chapter stresses the need to write in language that can be understood by laymen, and to document assertions made in EIS. These caveats apply to all parts of an impact statement. Section II gives examples pertaining to each part of the statement. The particular illustrations chosen under "Probable Environmental Impacts of the Proposed Project" are in no sense intended to be comprehensive. They were selected to illustrate difficulties which typically occur in dealing with a broad range of impacts. Air pollution and noise pollution, for instance, are impacts which lend themselves to technical measurement. They are discussed here to demonstrate approaches for the translation of this type of data into information useful in an EIS. The discussion of solid waste disposal, on the other hand, was included to point up the need to deal with seemingly minor impacts and their secondary effects. Sociological impacts are used as an example of the handling of soft data and its coherent presentation for impact assessment purposes. The last two sections attempt to clarify, through comparison of examples, the definitions and methods of presentation of "long versus short-term" and "irreversible and irretrievable commitments."

For lack of space, examples of and commentary on other problems in the writing and reviewing of EIS have not been included in the text. Some interagency comments and responses are, however, mentioned in Section II D, and the need for including adequate data in the Draft Environmental Impact Statement (DEIS) in order for the public hearing process to be successful is noted briefly in Section I.

Several other items pertaining to the EIS preparation and review process, and not discussed in the text, also deserve mention. First is the need for federal, state and local agency consultation and cooperation in preparing EIS. All too frequently we encountered cases where the sponsoring agency, in the DEIS, recommended action in an area outside of their field of expertise, but without consulting persons and/or agencies actively working in that field. The result was generally a spate of critical comments during the review process, and in the end a complete rewrite for the Final Environmental Impact Statement (FEIS). A letter or a phone call could have avoided the whole situation. Further, a single project can often serve the needs of several agencies with a minimum of extra effort and cost. In one case we examined the highway department bought right-of-way on a flood plain up to the maximum allowed by law, but used only what was needed for the road and, by prior agreement, turned the remainder over to the local conservation district for inclusion in a park. Interested parties and participating agencies should be alert for such possibilities and make every effort to capitalize on them.

Second, we want to stress the desirability of EIS reviewers making a personal reconnaissance of project sites. We attempted this exercise with several statements and turned up some wide gaps between the claims made on paper and the situation as we found it. For example, in one case a sponsoring agency overrode objections to the design of a proposed road improvement past the entrance to a heavily used county park. The park authorities, noting a high rate of accidents at the entrance, had asked that the improvement include turning lanes and a blinker. The sponsors replied that widening the two-lane pavement to 24 feet and providing for eight-foot all-weather shoulders should be sufficient to handle the expected traffic. When we examined the project we discovered that the speed limit on this stretch of highway is 65 miles per hour, a fact not noted in the EIS. It appears that this situation makes a left turn into the park from the west lane without the help of turning lanes and a blinker unnecessarily hazardous. Unless a reviewer made a site visit he would be unaware of this problem, and thus the project could go through without its being satisfactorily evaluated, or any possible solutions advanced.

The following outline is provided so that this chapter can be used as a reference to commentary on and examples of particular EIS elements.

I. DOCUMENTATION AND DEFINITIONS

A. DOCUMENTATION

In a recent report to the Subcommittee on Fisheries and Wildlife Conservation of the Committee on Merchant Marine and Fisheries, U.S. House of Representatives, concerning the adequacy of selected environmental impact statements,[1] the General Accounting Office commented on the frequent instances of unsubstantiated assertions in the texts they reviewed.[2] Tracing these assertions back to their sources, G.A.O. found they usually had no basis in hard data but rather represented off-the-cuff judgments by the writers based on their professional experience. There are, of course, situations when this type of judgment is called for in preparing EIS. Moreover, in light of NEPA's failure to provide federal agencies with either money or staff to write EIS, there is an ever present temptation to cut corners by using unsubstantiated assertions, thereby avoiding the trying and time consuming task of obtaining hard data. This tactic, however, backfires frequently. In the long run, especially if the project is controversial, a reviewer is likely to challenge the assertion, ask for documentation, and thus the work must be done anyway.

In the example cited below, excerpted from the EIS for a Federal Aid Urban (F.A.U.) Route, the unsubstantiated assertions went unchallenged through both draft and final statements, perhaps because the writers carefully hedged their bets by using such "weasel words" as "anticipated," "assumed," "could," etc. But nowhere is there any data cited to support their suggestion that improving the road in question would

---

[1] Adequacy of Selected Environmental Impact Statements Proposed Under the National Environmental Policy Act of 1969, Washington, D.C., General Accounting Office, Nov., 1972.

[2] See, for example, pp. 25-31.

raise property values and hence tax yield. In fact, a close reading of plans appended to the EIS makes it clear that the road will be brought several feet closer to the homes lining the street, homes whose setback at present is marginal. One wonders, therefore, whether an increase in traffic noise heard inside the residence, and the disturbance it creates, would not offset any appreciation in value from improved road access.

> It would be anticipated that an improved street of this type could have a slight effect on property values. It is assumed that this effect would normally be an enhancement, and could reflect in taxation. Any effect of this type is considered to be minimal.

To be in compliance with NEPA's provisions, the originating agency should ensure that all the necessary documentation on potential environmental impacts is included in the draft statement. For example, in the case of such environmental components as vegetation, topography, soil conditions, or drainage patterns that might be affected by a project, the DEIS should include a brief description of each component as it exists prior to the start of the project, a statement of the expected impact of the project on that component, and an explanation of how that impact was determined, i.e., what source was used, or what agency or person contacted.

The use of completely unsupported assertions, as in the following examples, should be avoided at all costs. The reviewer cannot afford to take it on faith that various aspects have been investigated; he needs documentation. Only in this way can the EIS review process be effective, and the primary purpose for holding public hearings--to gain informed public input--be fulfilled.

> The By-pass will not adversely disturb the ecological balance of the surrounding land or water area.
> *** ***
> Environmental characteristics considered in the design of the bypass include the physical terrain through which the alternate alignments might pass such as soil and subsoil conditions, drainage patterns, flood areas unfit for intense urban development, historical and archaeological sites, extent of urbanized areas, and land parcel size. All of these factors have been investigated.

> Development plans for this area include future industrial, commercial, residential and conservation land use as an expansion of . . . In this connection, flood plains, areas of possible highwater and similar factors have been reviewed and found to be of minor consequence.
>
> *** ***
>
> There are no known archaeological or historic sites or unique geologic features involved with this project.

The following are further examples of undocumented assertions, with commentary. In the first illustration traffic projections are used without any indication of their source, the data on which they are based, the date or dates the data was procured, the methodology involved, etc. This makes it impossible for the reviewer to judge the validity of the predictions. Moreover, statements such as that in the last sentence can only confuse the issue. Are the writers referring to 10% of the total predicted traffic? If so, the actual figures should be used.

> 2. Projected 1994 Traffic
>
> The 1994 traffic projections for both of the alternate alignments considered is shown in Exhibit 8d. 1994 average daily traffic volumes range from 16120-5760.
>
> *** ***
>
> The best estimate of the traffic two (2) years after the anticipated completion date of 1975-1976 is approximately 70 per cent of the projected 1994 average daily trips. The generated traffic two (2) years after completion is approximately 10%.

In the second illustration, dealing with the probable impact of a proposed road improvement, the writers of a DEIS for a F.A.U. Route assert that:

> "The improvement does not divide or disrupt an established community, or divide existing uses, e.g. cutting off residential areas from recreation areas or shopping areas, or disrupt orderly, planning development."

This is perhaps true in the strictest sense of the word, but the increased traffic which the improvement is expected to generate appears likely to hinder access for children to a neighborhood park. Since the route passes through a relatively new middle income community, the median age of whose residents is low, substantial numbers of

children may be affected. For this reason, a blanket assertion was unwarranted and this situation should have been explored, surveys made to determine the amount of the impact, and the results included in the DEIS. One should keep in mind that the reviewer will not always be able to visit a project site in person, and must thus be given adequate information on all impacts in the DEIS so that he can make an informed assessment of the proposal in question. The same statement also asserts that:

> "The improvement does have a significant positive aesthetic and visual effect."

Since the project involves street widening, which will decrease the already marginal setback of houses along the route, as well as requiring the removal of a number of trees, hedges and other vegetation, and since the only provisions for post-project landscaping are grading and seeding, the blanket assertion seems unjustified without some explanation of the basis on which it was made.

In the two final illustrations incomplete references are given, making it extremely difficult for the reviewer if he desires to verify their findings. Statements about impacts must be fully documented, either by indicating the source in the text, or by the use of footnotes. The inclusion of a bibliography in the EIS listing source materials used in its preparation is also a must.

> Based on findings in the Metropolitan Area Rapid Transit Feasibility Study and experience at Cleveland, Ohio this diversion is expected to equal 15%-20% of airport passengers in addition to non-airport users and would result in additional capacity on the highways leading to the airport.

> The Big Muddy River (in addition to being tentatively designated a "scenic river") and its related tributaries have been the subject of a comprehensive report formally submitted to the Water Resources Council in Washington, D.C. The ultimate goal of the report is to initiate Federal participation in implementing a plan of improvement of the entire river basin area--an area of some 2,400 square miles. The committee responsible for the plan was chaired by the U.S. Army Corps of Engineers and included representatives of the U.S. Departments of Agriculture; Commerce; Health, Education, and Welfare; Interior; Federal Power Commission; U.S. Environmental Protection Agency; and the State of Illinois. The overall plan

involves such projects as channel improvements, single and multi-purpose reservoirs and recreation corridors, and contained both short range and long range objectives. A recreation corridor along the Big Muddy River was designated as one of the short range objectives, hopefully to be achieved within the next 10 to 15 year period. The above recommendations will hinge, to a great extent, upon whether or not Federal participation is forthcoming.

To conclude, if you make an assertion, document it; if information is lacking in an area, go after it; and if, after a reasonable effort, you can't come up with hard data, say so.

B. DEFINITIONS

A second aspect of the EIS which can cause problems for the reader is the use of jargon or unfamiliar terminology, particularly in the more technical sections. This is an especially important factor where a project is controversial and citizen interest runs high, for language whose meaning is not clear can impede the sponsoring agency's ability to get its message across and to elicit informed public response. Thus it behooves the writer to keep his audience in mind. He should recognize that even the most highly skilled reviewer may on occasion be uninformed in certain areas covered by the EIS, and need to have things explained in straightforward language if he is to understand them.

On the other hand, there are limits on the extent to which technical language can be eliminated. In such cases definitions and/or explanations of the terminology used, as in the example below taken from a FEIS for a federal highway, are helpful. The same recommendation would apply where unfamiliar techniques are being used in the analysis. A short explanation of what is involved is desirable.

C - Physical Impact of the Project

Definition Level of Service is a term which denotes the different operating conditions which occur on a given roadway when accommodating various traffic volumes. It is a qualitative measure

of the effect of a number of factors, including speed and travel time; traffic interruptions; freedom to maneuver; driver comfort and convenience; and, indirectly, safety and operating costs. Six levels of service have been established, designated A through F. Level A is the best operating condition with Level F being the lowest.

In practice any given highway or section thereof may operate at a wide range of level of service depending on the time of day, day of week, period of the year, or even between years. Level A indicates a condition of free flow, with low volumes and high speeds with no restriction in maneuverability. Level F, however, describes a forced flow bumper-to-bumper operation with low speeds where stoppages can occur for indefinite periods.

Factors which have a restrictive influence on capacity are: lane width, roadway shoulders, absence of auxiliary lanes, surface conditions, alignment and grade.

II. ELEMENTS OF ENVIRONMENTAL IMPACT STATEMENTS

A. THE DESCRIPTION OF THE PROPOSED PROJECT AND ITS SURROUNDINGS

By rights, a description of the proposed project and its surroundings should not present any difficulties for the person preparing an EIS. The material called for by the CEQ guidelines is quite straightforward. Thus, it is disappointing to note, based on our sample of EIS, that this section is often one of the weakest in the statement. The problem appears to be one of inadequate care taken in preparation of the section, perhaps because the task required seems so simple that the writer automatically tends to concentrate on areas, such as probable impacts, which require more effort on his part.

From the point of view of the sponsoring agency, this situation can be self-defeating. The project description is generally the first chapter in the EIS, and it is from this section that the reviewer will be drawing his initial estimates of the quality of the report. If the description is sub-standard, chances are good that the reviewer will read the remainder of the EIS with a much more critical eye, and be harder on it in his comments. Most emphatically, we are not advocating here any attempt to put the reviewer off his guard with a sparkling introduction followed by little else of substance. Rather, we feel that EIS represent such an investment in time and effort that this work should not be jeopardized by a lackluster introduction. In short, it behooves the sponsoring agency to put its best foot forward and take pains with the description of the project and its surroundings.

As an example of a well planned and executed description of a proposed project and its surroundings, we are including an excerpt from a corridor report for Trunk Highway 212 in Yellow Medicine, Chippewa and Renville counties, Minnesota. In a minimum of words it covers such topics

as the background of the project, the standards to which it will be built, its proposed routing, the basic design for the highway, the location of interchanges and grade separations, the nature of the terrain the route will traverse, the amount of expected traffic, and any expected conflicts with existing land use. In short, it gives the reader an overview of the project and the environment into which it is going, and sets the scene for a more detailed consideration of critical factors in subsequent chapters.

We want, in particular, to call your attention to four paragraphs in the excerpt. The first (paragraph 7) discusses the terrain through which the road will pass. Note the emphasis given to routing the highway so that it utilizes marginal land wherever possible and avoids areas with significance as wildlife habitat, etc.

The second paragraph of note (paragraph 9) deals with traffic projections for the project. Note that the source of the information and the date of the survey are included here. These have been omitted in not a few of the EIS we have reviewed, apparently because the sponsoring agency, not having made the effort to run a new survey, used dated data. It goes without saying that this places the validity of their projections in doubt, and negates the purpose of the EIS. We cannot stress strongly enough the need to use current data in an EIS.

The remaining two paragraphs of interest (paragraphs 11 and 12) concern possible conflicts in land use. Note the attempts to make the route compatible with the Granite Falls Comprehensive Plan, thereby avoiding a possible conflict. Note also the concern to avoid taking land with recreation or historical value. Working out such arrangements may take time, but they have a payoff in enhanced public confidence in the sponsoring agency.

II. Description of the Proposed Highway Improvement and Its Surroundings

In December 1970, the West Central Minnesota Expressway Corridor Selection Study was completed. Trunk Highway No. 212 from Montevideo to Glencoe was selected as the expressway corridor to serve Central Minnesota. The proposed project is presented as the first stage construction for the proposed expressway. This report documents the compatibility of the Minnesota Highway Department's selected T.H. 23 location with the possible location of T.H. 212 in the Granite Falls area.

To provide the standards necessary for this high type expressway facility requires control of access and a design speed of up to 70 miles per hour. To apply these standards to the present route through Granite Falls would present intolerable problems, as to relocation of businesses and homes, and the changing of the layout and function of adjoining streets and entrances. To provide the desired expressway standards for T.H. 212 a bypass of Granite Falls is essential.

As a result of studies made, the south bypass route (Alternate "S" on the index maps) is the route preferred by the Minnesota Highway Department. The proposed project (Alternate "S") begins on present T.H. 212 approximately one mile northwest of the west junction of T.H. 23 and T.H. 212; and thence traverses on new location bypassing Granite Falls on the west, south, and east to terminate on present T.H. 212 approximately 5 miles east of Granite Falls. The project also includes a one-half mile connection for T.H. 23 east of Granite Falls. The length of the proposed project is 8.5 miles.

The south route (Alternate "S" on index maps) is described as follows: Beginning at a point on the present centerline of T.H. 212 on the south line of Section 30, Stony Run Township; thence running southeasterly on new location to a point near the intersection of the Burlington Northern Railroad and Chippewa County and CSAH No. 39; thence running easterly approximately one mile; thence run southeasterly to cross the Minnesota River one half mile north of the present T.H. 67 and T.H. 274 junction; thence easterly one and one half miles to near the center of Section 12, Granite Falls Township; thence running northeasterly to a point one eighth mile west of the northeast corner of Section 12, Granite Falls Township; thence run easterly to intersect with present T.H. 212 at the N.E. corner of Section 8, Hawk Creek Township, and thence terminate.

The T.H. 212 bypass of Granite Falls is proposed as a four lane expressway. With the exception of the east two miles, the proposed project provides freeway standards. The roadbed centerlines as proposed will be separated 90 feet with a depressed medium area. Right of way will generally extend 100 feet outside each roadbed centerline for basic corridor width of 290 feet. Access will be fully controlled with service to adjacent areas and access to Granite Falls restricted to five interchanges and grade separations described as follows:

1. At the intersection of present T.H. 23 bypass west of Granite Falls.

2. A separation structure at the junction of CSAH 39 over the T.H. 212 bypass.

3. An interchange at the west junction of proposed T.H. 23 and T.H. 212 bypass, south of Granite Falls.

4. A grade separation at the intersection of County Road 40 and the T.H. 212 bypass.

5. An interchange at the east junction of proposed T.H. 23 and the T.H. 212 bypass, approximately 5 miles southeast of Granite Falls.

The east two miles of the project from the east T.H. 23 connection to its eastern terminus, will be constructed to expressway standards with at-grade crossings of road intersections. Roadbed centerlines will be separated 124 feet for a basic right of way width of 324 feet. Control of access will be maintained.

The proposed project traverses on new location through rocky pastureland and cultivated fields. Approximately 70% of the 8.5 mile route traverses marginal pasture and/or open land, too rocky and/or rolly for cropland and too sparse for good wildlife cover. There are several small ponds of perched water lying between T.H. 67 and the Burlington Northern Railway, south of Granite Falls. To preserve these ponds for wildlife habitat, a study was made to develop a corridor to avoid major ponds and providing an alignment compatible with the necessary geometrics of the project.

A bridge crossing of the Minnesota River will be required southeast of Granite Falls. The River crossing will be at approximately a right angle, where the river banks are low with only a narrow band of stunted trees along them. For planning purposes, a contract letting date of 1977 has been established for the initial stage of this project.

Systems Planning and Analysis Report S-71, dated December 1971, was prepared by the Office of Systems Planning, Minnesota Highway Department to evaluate the 20-year projected traffic of the project. The report indicates that the segment of combined T.H. 23 & 212 will average 6700 vehicles daily and the segment east of the T.H. 23 interchange will average 5900 vehicles daily. The chart below lists present and projected traffic for the T.H. 212 bypass.

Average Daily Traffic

*Segment	1970 Traffic	Opening Year 1980 Traffic	1982 Traffic	Generated Traffic 2 yrs. After open.	1996 Traffic
A	1540	3480	4106	626	4660
B		5280	6130	850	7060
C		5040	5862	822	6700
D	1460	4440	5202	762	5900

*Segment Descriptions

A West of present T.H. 23 & 67 Junction

B Combined T.H. 67 & 212 south of Granite Falls

C Combined T.H. 23 & 212 east of the Minnesota River

D T.H. 212 east of the east T.H. 23 interchange

Presently, all but 1.2 miles of existing T.H. 212 from Montevideo to Danube is constructed as a two-lane, 20 foot wide roadway with 6 foot gravel shoulders. This present roadway was constructed in 1932 as a 20 foot wide concrete pavement and in 1966, was overlaid with bituminous surfacing. A 1.2 mile urban section in Granite Falls was regraded in 1969 and constructed as a four-lane undivided highway. Traffic capacity in Granite Falls is restricted by uncontrolled access and by the lack of auxiliary lanes on the 48 foot wide roadway to permit turning movements or parking. Traffic in this section is constricted by a narrow railroad overpass on the western terminus and on the eastern terminus by Bridge 5045 (Minnesota River) with its 27 foot roadway width.

Basic right of way width for existing T.H. 212 is 100 feet with no access control. The proposed bypass is compatible with the Granite Falls Comprehensive Plan for proposed land use. The Yellow Medicine County Park Board is considering land acquisition between Memorial Park and the golf course. The area in

> question measures some 300 acres of hilly, semi-wooded, rock out-crop land extending from T.H. 67 easterly to the Minnesota River. It is proposed to reroute T.H. 67 through traffic to the proposed T.H. 23 alignment. This will provide a safer, quieter area compatible with its recreation and park potential. A preliminary reconnaissance survey conducted by the Minnesota Historical Society indicates that some indian burial mounds and camp sites may be endangered. The sites will be ascertained, located, and considered in the selection of the final location.
>
> This proposal does not require the use of any land from any publically owned park, recreation area, wildlife or waterfowl refuge, or historic site having national, state, or local significance; therefore, the requirements of Section 4(f) of the National Environmental Policy Act of 1969 do not apply.

The following example, taken from the FEIS for F.A. Route 64 (Illinois Route 47) from the west junction with U.S. Route 150 in Mahomet to a point approximately 1.2 miles south of the Ford County Line, is cited because of its listing of specific locations along the right-of-way that will require extensive work, and brief descriptions of the nature of that work. This is a useful device for calling the attention of the reviewer to areas where a project's impact is likely to be greatest. This list would be particularly handy where the reviewer does an on-the-scene inspection.

> Design criteria applicable to the rural portion of the improvement (from Interstate Route 74 to the north termination) are given below.
>
> Construct to full functional class design standards except that 8-foot stabilized shoulders and slopes utilizing existing right-of-way will be permitted. Correct all deficiencies in horizontal and vertical alignment that do not meet 60 miles-per-hour design standards. All corrections are to be made to 70 miles-per-hour design standards. Federal approval will be required.
>
> *** ***
>
> In order to comply with the design criteria most of the rural improvement will be accomplished by widening the existing 18-foot pavement to 24-feet, constructing 8-foot stabilized shoulders, and grading the slopes within the existing 80-foot right-of-way (See page 31). The specific locations requiring more extensive work are listed individually below and shown on Exhibit "B", (See page 30).

1. One to one and one-half miles north of Interstate Route 74 two hills are to be cut down to provide adequate sight distance.

2. In the fifth mile north of Interstate Route 74 two more hills are to be cut down to provide adequate sight distance.

3. Four and one-half miles north of Interstate Route 74 a stream bridge is to be raised.

4. Five miles north of Interstate Route 74 the reverse curve is to be relocated in order to provide for 70 miles-per-hour vehicle speeds.

5. In the first mile south of U.S. Route 136 the grade is to be raised approximately 2-feet to prevent flooding of the pavement during periods of heavy rain.

6. Approximately three-tenths of one mile south of the north termination of the improvement a stream bridge is to be replaced.

7. Throughout the northernmost one mile of the improvement new ditches will be constructed to promote drainage and improve sight distance.

In areas of relocation, grade change, or new bridges the stabilized shoulders will be constructed to ten-foot width and foreslopes will be sloped at a rate of 6:1. The backslopes will be built to a slope of 4:1 (See page 31). These more demanding requirements will necessitate acquisition of approximately 80 to 85 feet of additional right-of-way through the specific locations listed above.

The citation below, taken from the design stage DEIS for F.A.P. Route 171, Illinois 76 (Belvidere Bypass), Boone Co., Illinois, is an example of a well written summary of the transportation environment into which the proposed highway will go. It has both the clarity and thoroughness which one should strive for in describing the project area and the existing facilities. Note in particular the description of the existing bridge network and the explanation of why upgrading it is not an acceptable solution.

I. DESCRIPTION OF THE PROPOSED HIGHWAY IMPROVEMENT AND ITS SURROUNDINGS

A. Study Area and Existing Facilities

The study area is more or less centered around the community of Belvidere, Illinois. (See Exhibits 1 & 2)

The study area contains several significant transportation modes. These modes are:

1. Railroad
2. River
3. Highways

The Chicago and Northwestern Railway runs parallel to the Kishwaukee River through Belvidere. In the past the railroad and the river served to spearhead development in the area but are not significant to development presently.

The remaining transportation mode is highways. The study area contains several significant highways, including the Northwest Tollroad (Interstate 90) which extends from the Chicago metropolitan area to Rockford and to the Wisconsin State Line. As this tollroad (I-90) is not a free highway, commercial traffic destined for this area, and home-to-work traffic, is very reluctant to use it on a daily basis. This type of traffic resorts to the tollroad (I-90) primarily in inclement weather. As a result, Illinois Route 76 carries a large volume of commercial vehicles.

Other roads in the area include U.S. Business Route (B.R.) 20, and U.S. Bypass 20 around the southern part of Belvidere. The U.S. Bypass 20, completed in 1967, is a partially access-controlled facility and is a four-lane divided highway that bypasses the east-west traffic outside the Belvidere central business district.

U.S. Business 20 and Illinois Route 76 converge north of Belvidere and become one as they enter the community. They continue as one half way through the community and then diverge: U.S. Business 20 going easterly to connect with Bypass 20 and Illinois Route 76 going straight south to connect with Bypass 20.

Another significant factor about the highway network is that there are only four bridges across the Kishwaukee River in the study area. One of these bridges is an antiquated one-lane bridge on a local street that does not have continuity, through Belvidere. Thus, only two bridges connect the northern with the southern half of the community.

> Consideration of the upgrading of these remaining two links is not feasible because of potential disruption, impact, derogation, and destruction of existing downtown business property, residential areas and recreational-park facilities. This improvement would not provide for the urbanization outside the central hub of the City or the relief of through traffic on an already congested roadway.

In the descriptions of proposed projects and their surroundings which we have just reviewed, the emphasis has been on content and clarity of expression. Without downgrading the importance of these two items, for they do determine the worth of this section, let us turn for a minute to another element, the format. As we have already noted, because this is generally the first chapter of the EIS, the reader is likely to be drawing his initial impressions of the statement from it. Thus an imaginative or unusual format can work to the sponsoring agency's advantage by catching the reviewer's eye and holding his interest.

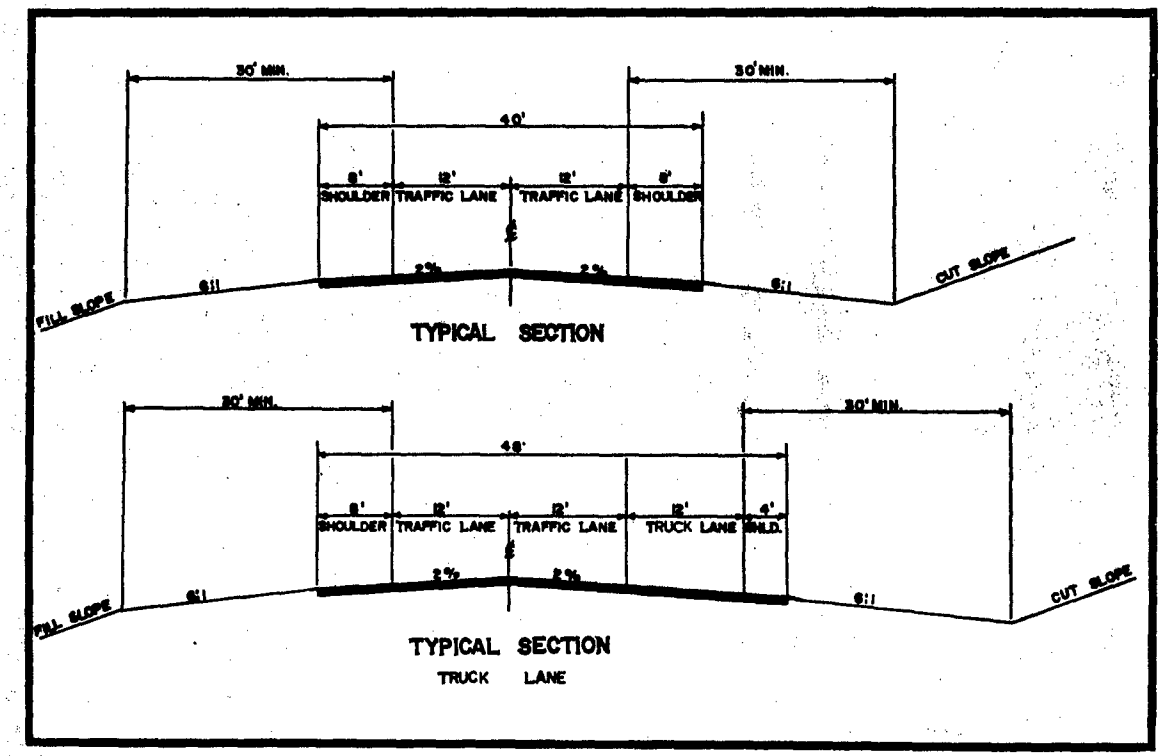
In the example printed below, taken from the FEIS for U.S. Route 40--McGuire Canyon to Strawberry Valley, Utah, the authors have made imaginative use of maps, illustrations, type styles, contrasting colors of ink and paper stock, etc., to produce an arresting product which held this reader's attention from start to finish. Several facets of this presentation deserve special notice. First, there is the use of concise statements. The data are all there, but without any unnecessary elaboration. Second, there is the use of panoramic photographs to show the surroundings of the project. Short of being there, one could hardly get a better feel for the terrain or the problems with the existing road than these photographs give. Moreover, having viewed them, the reader has little need for a further written description.

Finally, a word of caution is necessary. A Madison Avenue style presentation is no substitute for hard data. In commending the U.S. 40 EIS, we at the same time want to warn against the temptation to turn out a slick product in the hope that its layout will disguise its lack of substance.

PART I — DESCRIPTION

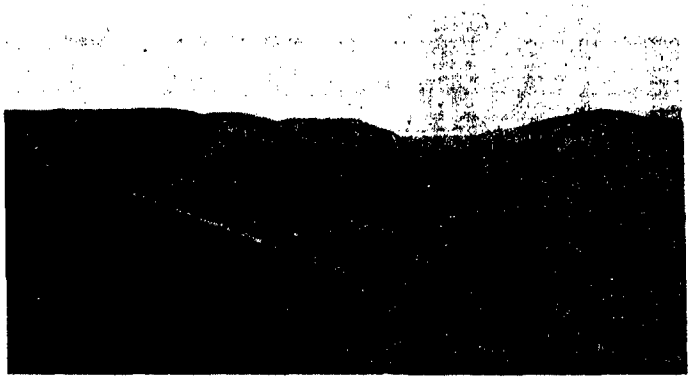
Type of Facility	Improvement to, and updating of, a segment of an existing two-lane highway
Length	10 miles
Termini	McGuire Canyon on the northwest; Strawberry Valley on the southeast (at each terminal the proposed project is to connect to a recently-improved section of highway)
Basic Traffic Data	1970 Average Daily Traffic (ADT) – 2245 (12.5% heavy trucks, 25.5% light trucks) 1990 ADT – 4200 Design Hourly Volume: 23% of ADT; 8% commercial (heavy trucks) Capacity –Greater than 5,000 ADT at level of Service B
Right-of-Way	200 feet in width (minimum)
Location	98% on existing highway alignment

PART I – DESCRIPTION



Major Design Features	Two 12-foot lanes; Two 8-foot shoulders; 30-foot safety recovery zone; 6% maximum grade; Truck climbing lanes through canyon areas; One major structure over the Strawberry River; Limited access control; All intersections at grade.
Surrounding Terrain	Mountain canyon and valley plateau

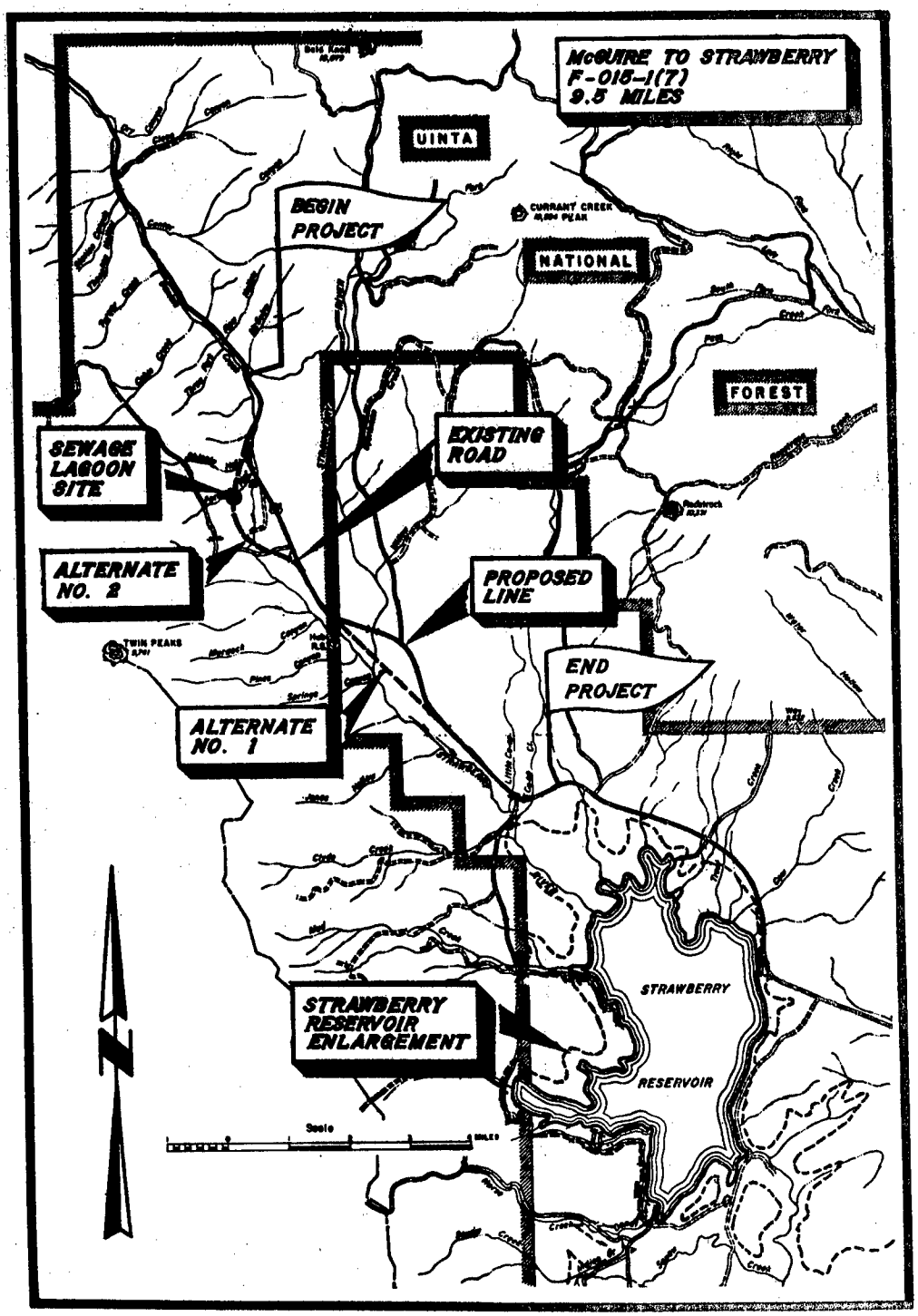
Strawberry Valley - facing southeast



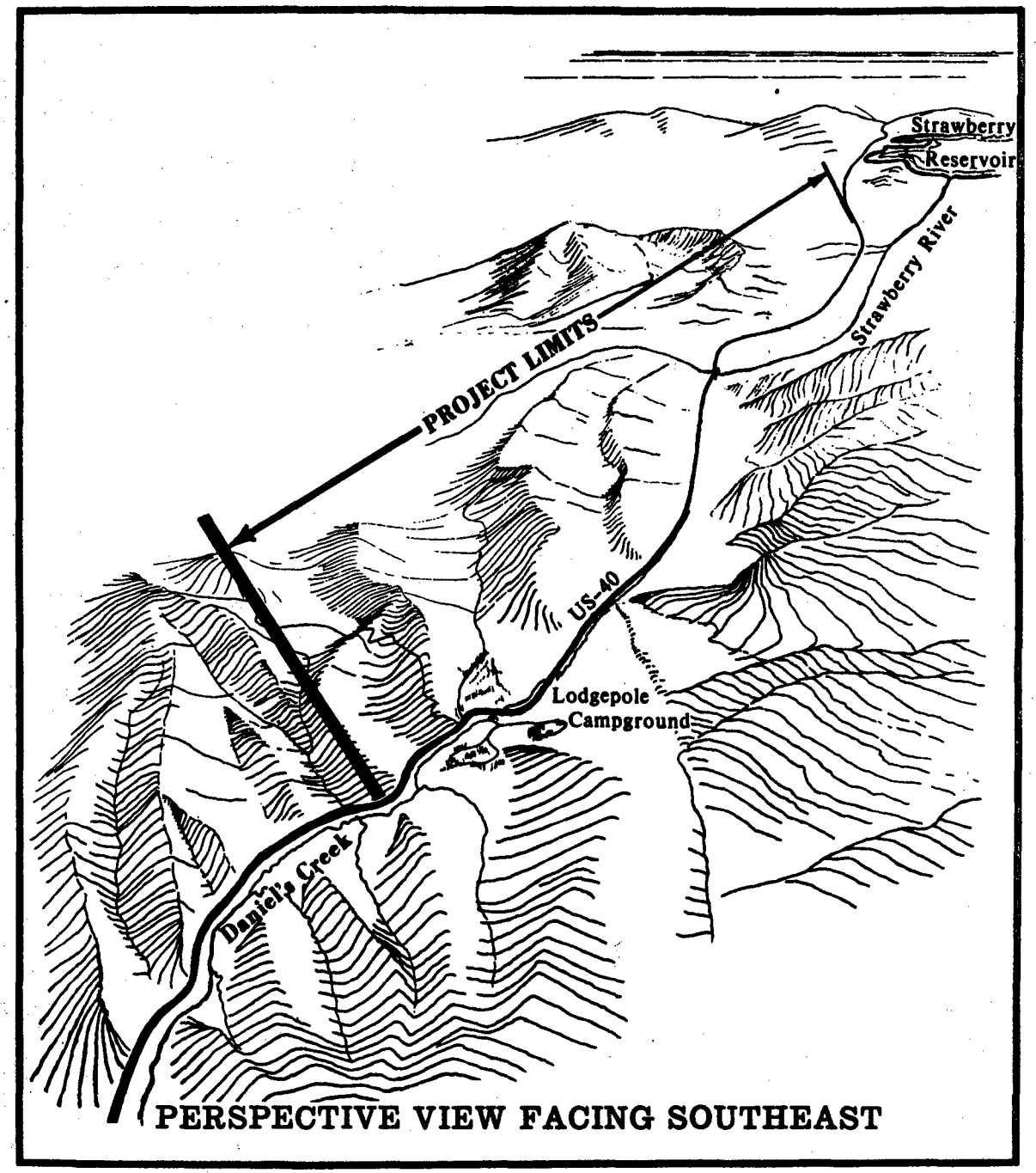
Overlooking Strawberry Valley - the Strawberry River passes left to right through the center of the photograph

PART I – DESCRIPTION

Land Use	Hunting, fishing, camping, grazing, some lumbering and transportation
Highway Deficiencies	Steep grades, narrow shoulders, sharp curves. From the Adequacy and Needs Study conducted in 1968: Condition – 13 out of 35 Service – 31 out of 40 Safety – 21 out of 25 TOTAL Adequacy Rating – 65 out of 100 (Generally, an adequacy rating of less than 75 out of 100 suggests immediate reconstruction or replacement.)
Need for the Proposal	Primarily to reduce maintenance costs and to complete updating of U.S. Route 40 from the Wasatch Front to the Colorado State Line


McGUIRE TO STRAWBERRY
F-015-1(7)
9.5 MILES
UINTA
BEGIN PROJECT
NATIONAL
FOREST
EXISTING ROAD
SEWAGE LAGOON SITE
ALTERNATE NO. 2
PROPOSED LINE
END PROJECT
ALTERNATE NO. 1
STRAWBERRY RESERVOIR ENLARGEMENT
STRAWBERRY
RESERVOIR

PART I – DESCRIPTION



PERSPECTIVE VIEW FACING SOUTHEAST

B. ALTERNATIVES TO THE PROPOSED PROJECT

In one of its more confusing stipulations, the National Environmental Policy Act of 1969 requires (section 102(C) (iii)) that each environmental impact statement consider alternatives to the proposed action. Probably more EIS have been derailed because they failed to satisfactorily comply with this regulation than for any other single cause. The major problem seems to be that there is no agreement on the meaning of the stipulation, i.e., is it to be interpreted broadly or narrowly? For example, take the case of highway projects, which have generated the majority of EIS filed to date. Is a discussion of alternatives satisfactory if, as some believe, the statement considers only other highway locations? Or is the question one of transportation in general, meaning that other modes of moving goods and people, such as rail or air, should also be examined? If the latter course is chosen, how does one deal with the fact that this may force a sponsoring agency to look at areas outside its legal mandate, and in which it has no expertise?

For answers to these questions we have had to turn to the courts. While the issue is far from settled, the general trend is toward a broad interpretation of the Act. Thus, in the case of Gillham Dam Environmental Defense Fund vs. Corps of Engineers (325 F Supp. 728, 749 (E.D. Ark. 1971)), where the plaintiffs contended that the project EIS inadequately examined the environmental factors involved, the judge, in ruling in their favor, commented that the defendant must "...explore all alternatives to dam building..." (emphasis ours). This point of view was further buttressed in the well known case of Calvert Cliffs Coordinating Committee, Inc. vs. AEC (No. 24, 839 (D.D. Cir. decided July 23, 1971)) where the plaintiffs successfully challenged AEC's implementation of NEPA. In his opinion, the judge ruled that the AEC must consider all environmental issues and not just those, such as radiation, in which it has particular expertise. These rulings, of course, offer little solace to those agencies who, as a result, find themselves confronting issues they are not equipped to handle. It is perhaps for this reason that there is a marked trend toward the use of consultants in such situations. Judging from our sample of EIS, this is a reasonable method of extracting oneself from a difficult situation. Several of the better statements we examined were prepared this way.

Having established the directions which legal interpretations of NEPA are taking, and having looked at some of the implications of this trend for the exploration and description of alternatives to a proposed action, we turn in the following pages to an examination of some aspects of the problem which appear to be troublesome for the writer. Particular attention is paid to the so-called "do nothing" alternative.

Analysis of Alternatives

Although the Council on Environmental Quality's guidelines for the preparation of an EIS call for both a rigorous exploration and description of alternatives to a project and an analysis of the environmental impact of each alternative, the latter stipulation is all too frequently overlooked. Such a statement places the reviewer in an awkward spot, for he is thus denied adequate data to fully compare alternatives with the recommended course of action. His only recourse, since NEPA does not provide an enforcement mechanism, is to note the deficiency in his review of the DEIS and hope that the sponsoring agency will heed his comments and revise their presentation in the final statement. In light of this, we can only encourage sponsoring agencies to consider the alternatives thoroughly the first time, noting at the same time that many of the lawsuits filed by conservationists which have succeeded in blocking projects have as their basis non-compliance with the CEQ guidelines on discussion of alternatives.

Some idea of the degree to which alternatives should be discussed is contained in the following excerpt, taken from the DEIS for Trunk Highway 212 in Yellow Medicine, Chippewa and Renville counties, Minnesota (Granite Falls Bypass). Note in particular the inclusion of estimated construction costs for each alternative. Too often--as in the second example printed below--no costs are imputed to an alternative. Even with the best of descriptions--and these are more than adequate--the reviewer will have a hard time comparing alternatives without some sense of the expenditures involved.

> V. Alternatives
>
> Alternate routes have been considered for T.H. 212 in the Granite Falls area. The south bypass route alternate

(Alternate "S" on index maps) is preferred by the Minnesota Highway Department, and does not conflict with the Granite Falls Comprehensive Plan for land use. It is our opinion that this preferred south alternate will create the least adverse impact on the future development and growth of the City of Granite Falls and the adjacent area. All alternates are under consideration and a specific alternate will be selected following a public hearing.

*** ***

The "Environmental Services Section" of the Minnesota Highway Department conducted a corridor selection study to determine the environmental feasibility of relocating T.H. 212 in the Granite Falls area. The study "Environmental Resource Inventory" (See Appendix "A") utilizes a multiple team concept. This "multi-disciplined team" concept utilized engineers, economists, landscape architects, biologists, etc. to collect data to be compiled, analyzed and mapped by computer. Values were placed on sixteen determinants according to the degree of impact each has on the human environment. Composite maps were developed summarizing highway site feasibility, environmental, social and economical considerations. By evaluating the composite maps of this report it appears feasible to consider two basic corridors. One corridor north of Granite Falls and a second, the preferred south corridor.

*** ***

North Route Alternative (Alternate "N")

A detailed study was made for an alternate routing north of the City of Granite Falls. The north route is not the preferred route because of the following reasons:

1) Construction costs of approximately 1.2 million dollars higher than the proposed south route. Estimation of construction costs from preliminary design data available for the two routes are as follows:

	(Alt. "S") South Route	(Alt. "N") North Route	(Alt. "S-1") South Route
Grading and Surfacing	$ 3,400,000	$ 3,600,000	$ 3,360,000
Bridges	(12) 2,700,000	(16)3,300,000	(12) 4,155,000
Right of Way	88,290	114,400	80,000
*Utilities Relocation	185,550	594,400	185,550
Total Est. Const. Cost	$ 6,373,840	$ 7,608,800	$ 7,780,550

*Utility relocation costs includes relocation for T.H. 23 as comparible with each route, other costs are for T.H. 212 bypass only.

2) Due to the rough terrain adjacent to the Minnesota River north of Granite Falls, construction of an adequate road connection from Alternate "N" to serve Granite Falls is not feasible or prudent.

   Because of the close proximity of the Chicago Milwaukee St. Paul & Pacific Railroad to the Minnesota River the grade line elevation of a bridge spanning the river would be determined by the elevation necessary to provide 23 feet of clearance over the railroad tracks. The landing area for the bridge would be in a flood plain area approximately 25 feet lower than the railroad tracks. Since this condition is prevalent north of the city providing a suitable access to service Granite Falls could be costly and difficult to construct. No allowance was made in the cost comparison for a road connection and Minnesota River bridge essential to service Granite Falls from the North route alternate.

3) An unusually high concentration of high capacity power transmission lines are located in the Granite Falls area. A major United States Department of Interior Bureau of Reclaimation sub-station, located one mile north of Granite Falls, at present, has 11 transmission lines feeding from this sub-station. Northern States Power Company's power plant east of Granite Falls has 11 transmission lines diverging from its plant.

   The estimated cost savings for utility relocation of the south route as compared to the north route is $408,850. Because of these significant savings, serious consideration must be given to the selection of the south bypass.

4) The proposed relocation of T.H. 23 when incorporated into the south T.H. 212 bypass route will reduce the travel distance from Cottonwood to Clara City by seven miles as compared to the present route. If the north T.H. 212 bypass were established, part of this T.H. 23 travel savings would be lost.

5) A T.H. 212 bypass north of Granite Falls would carry only T.H. 212 traffic if the proposed T.H. 23 relocation is developed as planned; whereas, a south bypass of Granite Falls with T.H. 212 would utilize a common alignment with segments T.H. 23, T.H. 274, and T.H. 67. If T.H. 23 was realigned to conform to a north bypass a relocation of T.H. 274 and T.H. 67 to provide more adequate transportation for this traffic would be necessary.

6) Adoption of a north route alternate would mean transporting the excess excavation material from the steep bluff area east of the river, where it is not readily useable in the heavy cut section, across the Minnesota River to be utilized in embankment in the low area west of the river.

Because of the close proximity of the bluffs and the C.M. St.P. & P. and the B.N. Railroad tracks to the Minnesota River, control of sedimentation and siltation would be difficult when bridging these embankment materials over the river.

On the basis of these reasons the north route is not considered feasible or prudent.

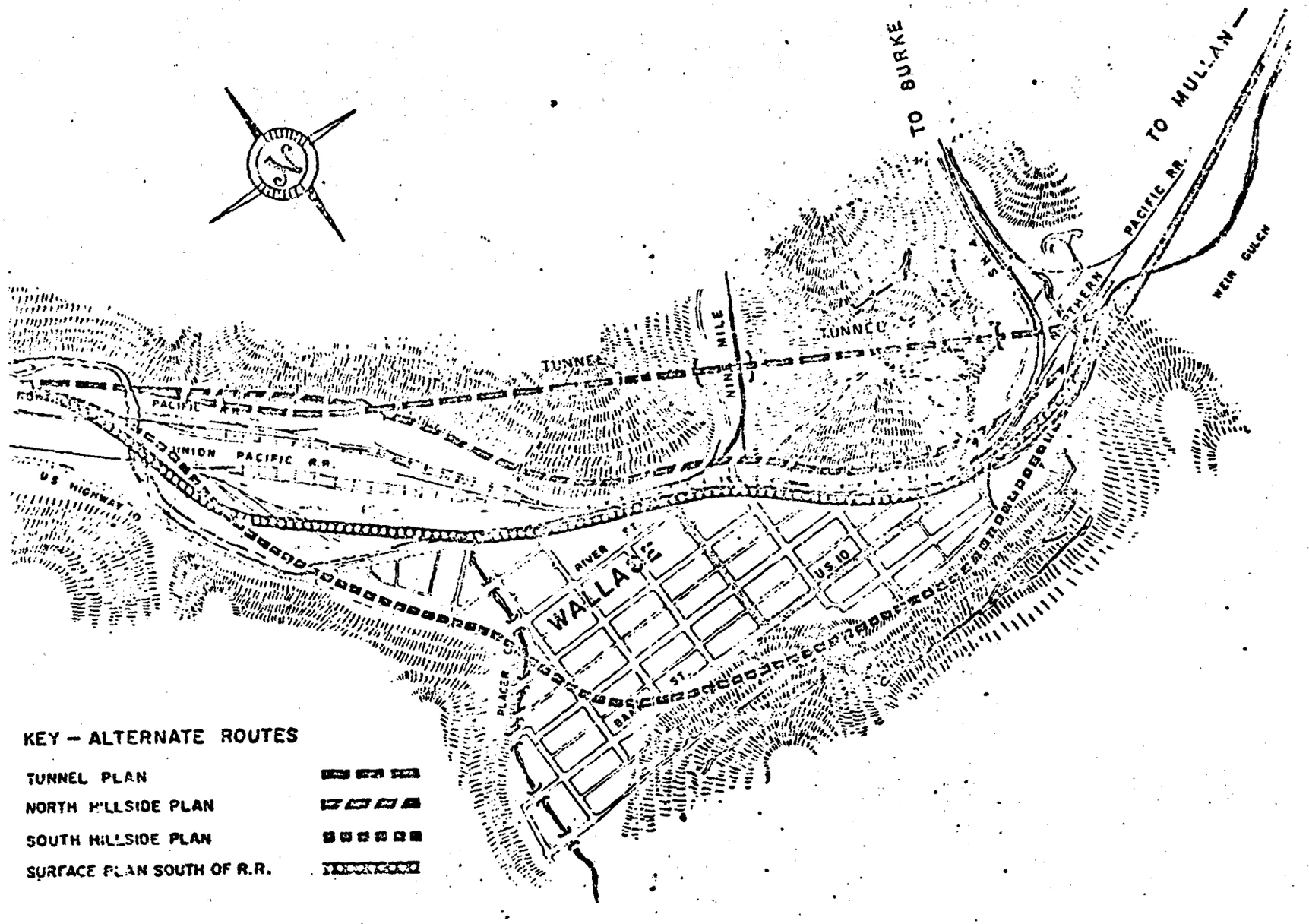
IV. ALTERNATIVES TO THE PROPOSED PROJECT

*** ***

The map on the facing page shows four basic alternative alignments which have been considered and studied. From the west boundary of Wallace to the east boundary, each plan would occupy a different location and would possess varying physical and traffic handling characteristics, in addition to different environmental effects.

The "Tunnel Plan" would occupy a corridor of 3.57 miles, with 3,270 feet of twin two-lane tunnels. Principal advantages of this alternative would be the small amount of property withdrawn from the community, somewhat shorter length, and the relatively superior alignment and median separation provided. Its disadvantages would be extremely high construction costs and high tunnel maintenance costs. In addition, geologic investigations have indicated unfavorable structural properties in the rock formations along the potential tunnel route.

The "North Hillside Plan" would occupy a 3.67 mile corridor and require an 1,100 foot long structure near the east end of the project to carry the freeway over State Highway 4, U.S. Highway 10, the railroads, and the river. Principal advantage of this plan would be the relatively minor structure requirements. Chief disadvantages are associated with the large side hill cut which would be approximately one-half mile long and over 500 feet deep at the point of maximum cut. Disposal of about 3,000,000 cubic yards of excess material would pose problems, as would the difficulty of blasting on the hillside directly above the railroads and less than 300 feet from the high school and other buildings in Wallace business district. In addition, the large cut backslopes would lie on an equivalent $1\frac{1}{2}$:1 slope, and would present slide hazards to the Interstate highway and city of Wallace.


TO BURKE
TO MULLAN
NORTHERN PACIFIC RR.
WEIR GULCH
TUNNEL
TUNNEL
NINE MILE
PACIFIC R.R.
UNION PACIFIC R.R.
US HIGHWAY 10
RIVER ST.
WALLACE
US 10
PLACER
BANK ST.
KEY – ALTERNATE ROUTES
TUNNEL PLAN
NORTH HILLSIDE PLAN
SOUTH HILLSIDE PLAN
SURFACE PLAN SOUTH OF R.R.

The "South Hillside Plan" would require a corridor of 3.89 miles. The only advantage of this plan would be that of direct ramp connections to existing U.S. Highway 10 from the partial interchange west of Wallace. Immediate disadvantages are evident in the impact which any south side alignment would have on the residential area of Wallace. In addition, this alternative would have poor exposure and would be two-tenths of a mile longer than any of the other nontunnel plans.

The "Surface Plan South of the Railroads" would be 3.71 miles long and would require a 2,300 foot long structure just north of the Wallace business district. Advantages of this plan would accrue from the possibility of a full interchange at West Wallace and moderate interference with railroad facilities. Disadvantages include the dislocation of numerous properties, among them the high school and municipal library. Furthermore, the existing highway would be closed off for arterial use, necessitating urban street improvements. Resulting access to the Nine Mile Canyon and the Burlington Northern Railroad Depot would be awkward.

An additional "Modified Northside Elevated Structure Plan" was investigated. This plan would differ from the proposed Northside Elevated Structure Plan in that the Northwest Approach to Wallace would be located adjacent to the mountain side, thus requiring a less direct interchange connector. Since the length of the structure would still be substantial, 3,700 feet, and the interchange connector less direct, this plan was considered inferior to the Northside Elevated Structure Plan.

Maintaining the Status Quo

The Council on Environmental Quality's guidelines for the preparation of an EIS mandate consideration of the so-called "do nothing" alternative, i.e., what will be the environmental impact of maintaining things as they are without constructing the contemplated project. In the sample of statements we have read, this stipulation has seldom been adequately complied with. One of the better responses, taken from the FEIS for F.A. Route 64 (Illinois Route 47) from the West Junction with U.S. Route 150 in Mahomet to a point approximately 1.2 miles south of the Ford County Line, is cited below. It stands out from the others because of the detail used to make it clear why the "do nothing" alternative is not a prudent approach. It should be noted, however, that this detail was added only after criticism by reviewers of the original statement in the DEIS. This

statement is also included for comparison purposes. While it makes clear the tradeoff between unsafe highways and other environmental effects, it is too general to be satisfactory. It does not deal directly with the project in question; similar remarks could be made about dozens of other highway proposals.

Sullivan and Montgomery, in their recent review of highway impact statements, have noted the growing use of form paragraphs and vague generalities in place of facts.[1] We want to caution against this approach to EIS preparation. If the end product is to be meaningful, it requires findings rather than arguments, studies rather than opinions, and facts rather than generalities.

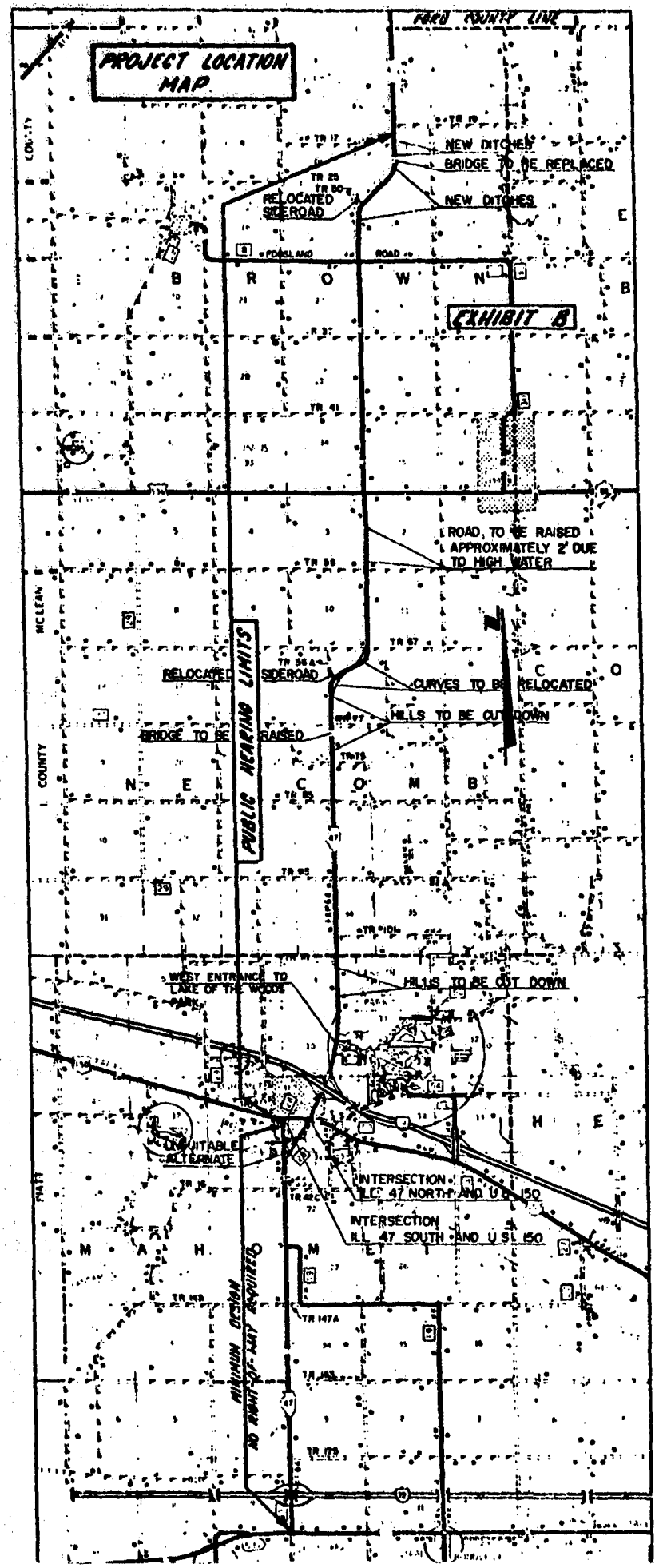
> Studies of the "do nothing" alternate show that ten unsafe areas (potential high accident locations, See page 30) exist within the project limits. The unsafe areas consist of vertical curves which afford too little sight distance, horizontal curves with radii too short to permit high speed negotiation, and stream bridges with insufficient lateral clearance. To "do nothing" requires the present traffic as well as increased future traffic to traverse these areas with the greater than average probability of having accidents.

> Obviously, if no improvement is made, the existing environment, as we know it, will not be changed. However, this then requires the motoring public, being a part of the environment, to continue to use the existing narrow, unsafe roadway. If this is the case, then the existing roadway is actually creating an adverse affect on the existing environment. This condition can be corrected if we consider the proposed environmental effects, as discussed in the remainder of this statement, to be less detrimental to the total environments than the existing effects of retaining the narrow, unsafe roadway.

---

[1] Sullivan, James B., and Paul A. Montgomery, "Surveying Highway Impact," Environment, November, 1972.

78


PROJECT LOCATION MAP
FORD COUNTY LINE
NEW DITCHES
BRIDGE TO BE REPLACED
NEW DITCHES
RELOCATED SIDEROAD
ROAD TO BE RAISED APPROXIMATELY 2' DUE TO HIGH WATER
EXHIBIT B
PUBLIC HEARING LIMITS
RELOCATED SIDEROAD
CURVES TO BE RELOCATED
HILLS TO BE CUT DOWN
BRIDGE TO BE RAISED
WEST ENTRANCE TO LAKE OF THE WOODS PARK
HILLS TO BE CUT DOWN
UNSUITABLE ALTERNATE
INTERSECTION ILL 47 NORTH AND U S 150
INTERSECTION ILL 47 SOUTH AND U S 150
PROJECT LOCATION MAP 30
BROWN
NEECOMB
MAHOMET
McLEAN COUNTY
PIATT COUNTY

The third example, printed below, is a typical discussion of the "do nothing" alternative, i.e., it abounds in general statements. Thus it mentions "future development planned both in the vicinity of the proposed project and within the Uintah Basin" without stipulating what that development is or indicating the type and amount of extra traffic it would generate. In similar fashion, the report refers to "...deficiencies which are evident in the present road" but does not list them, and to "...reducing the level of service, at times, to Level D," but does not indicate what the level means.

Often, as is the case here, such information is detailed in other sections of the EIS if the reader will take the time to dig it out. But putting the reader through that process defeats the purpose of the CEQ guidelines calling for consideration of the "do nothing" alternative, i.e., to insure that the impact of taking no action is given as much study as those other alternatives which call for implementing an action. To comply with this stipulation, it would at the minimum seem necessary to summarize all pertinent information concerning the no action alternative here, preferably with references to the pages which contain the more detailed discussions of each item. Only in this way will the reviewer have all the materials at hand to judge how adequately the sponsoring agency weighed the spectrum of alternatives in recommending a course of action.

This is a matter of no little importance, for there are some sponsoring agencies which have a vested interest in seeing projects go through, if only to keep their staffs occupied. EIS for these projects tend to start with the assumption that there is no merit in maintaining the status quo, and so the matter is never adequately investigated unless the statement is challenged.

Part IV - ALTERNATIVES

Status Quo	Future development planned both in the vicinity of the proposed project and within the Uintah Basin will result in increased usage of the highway; traffic will increase. Reconstruction of the roadway is planned to aid in providing increased safety, less inconvenience to the travelers and opportunities for better maintenance of the roadway. If the roadway is not improved, the increased usage with higher volumes of traffic will cause some congestion on the road with more delays and increased hazards.

By undertaking the proposed construction, it will be possible to correct some of the deficiencies which are evident in the present road. Road cut and fill slopes can be built to correspond better with the environment and can be reseeded to provide better erosion control and be more pleasing in appearance. The proposed project can lend not only an improvement to the roadway but an improvement to the areas adjacent to the roadway.

If construction were not to be undertaken, the highway would incur further limits on providing service, reducing the level of service, at times, to Level D. Increased loads are now affecting the riding qualities of the roadway and increasing the maintenance costs.

This section of highway has shown a greater number of vehicle accidents than the same length of highway adjacent. The number of accidents from historical evidence is likely to increase. Totals of accidents for previous years are:

	ACCIDENTS				
	1967	1968	1969	1970	TOTAL
Milepost 33 to 43 (This project)	13	8	12	25	58
Milepost 23 to 33 (Rebuilt in 1961)	7	12	10	24	53
Milepost 43 to 54 (Constr. in 1940 presently being reconstructed)	4	10	20	11	45

In short, the "do nothing" alternative would simply ignore a small existing problem which, by all available evidence, will develop into a large future problem tending to thwart economic and sociologic progress.

The excerpt below, taken from the DEIS for the Tijuana River Flood Control Project in San Diego County, California, is by far the most cogent analysis of the "do nothing" or no action alternative we encountered. Of particular note is the seemingly neutral approach to the issue taken by the authors, a consulting firm working under contract to the U.S. Army Corps of Engineers.

Their presentation is factual, and their discussion straightforward and without any hint of advocacy. This stance tends to lend credence to the EIS.

Several other aspects of this section also deserve comment. First, with regard to determining expected future land use patterns, note how the authors draw on the implications inherent in existing legal and other regulations governing floodplain use to arrive at an estimate of the amount of flood protection that would be available for each projected use should the project be shelved. This in turn allows them to predict what the likely land use patterns would be in that circumstance. And second, with regard to the hydrologic consequences of no action, note the authors' frank statement of the uncertainties involved. Rather than make a forecast, they have presented alternative schema based on the two most likely meteorologic possibilities, continued drought or a return to a normal rainfall regime. Such frankness is commendable. In general, EIS would be better documents if, when they lack precise answers, they say so.

> Expected Environmental Changes in the Absence of Flood Protection. The precise patterns of development which can be expected to take place in the lower Tijuana River valley in the absence of the proposed flood protection measures is difficult to predict because (1) the City of San Diego now requires that structures in the valley be designed to withstand a 50-year flood; (2) the location of the 50-year flood line (and the elevation of the 50-year flood level) has not been established throughout most of the valley; (3) the plans for the valley adopted by the City of San Diego (17) are based upon the existence of adequate flood protection measures; and (4) there is no way to predict whether the present drought is about to terminate or whether it will persist for many years to come.
>
> The Border Area Plan adopted in 1966 and the General Plan adopted in 1967 (and reapproved in January, 1970) by the City of San Diego for the development of the lower Tijuana River valley assume that a flood control channel will be constructed (17, 18). The City has made no plans for development of the valley floor in the absence of flood protection. It is, of course, possible to construct the residential and commercial improvements within the valley, and possibly a marina might be built within the estuary, even though flood protection is not provided. However, it is very unlikely that such plans will be carried out while a severe flood hazard exists.

If the proposed flood control plan is not implemented, it appears most probable that the development of the valley will be limited to (1) marginal areas which are presently safe from the 50-year flood and (2) recreational, agricultural, and highway improvements which can tolerate occasional inundation. If the appropriate governmental agencies were to make clear that flood protection would not be provided and that zoning for residential and commercial improvements was not contemplated, a marked reduction in land values and tax rates might be expected. Also, under such circumstances, one would expect landowners within the valley to seek tax relief under the California Land Conservation Act.

The absence of extensive developments in the lower Tijuana River valley can be attributed to:

1. lack of pressure for development prior to 1960, and

2. increasing restrictions on development since 1960 (and especially since 1965), which have been designed to prevent erection of structures vulnerable to flood damage.

During recent years the City of San Diego has become increasingly aware of the necessity of restraining developments on unprotected flood plains. Five years ago the City began to require that all structures placed in the lower Tijuana River valley be located on land at least 1.5 feet above the inundation level expected from a 50-year flood, which has an estimated flow rate of 50,000 cfs. The elevation of this 50-year flood has not been determined except in one location (9). Therefore, in order to obtain a permit to build on lands which lie within the design (300-year) flood inundation area (Figure 1), a developer must make an investigation to determine the elevation of the 50-year flood at the construction site. If it is determined that the land surface does not provide 1.5 feet of freeboard above the 50-year flood inundation level, then land filling must be carried out to provide the necessary elevation. If the developer finds that his land is the required height above the 50-year flood inundation level, then he is free to commence construction, even though the land may be below the design flood inundation level. In either case the developer must agree to payment of the necessary assessments when flood control is provided for the design flood.

Prediction of the future changes in land use will be partially based on the determination of the 50-year flood line. The determination of this line and corresponding elevations is a complex and time-consuming process beyond the scope of this report. However, it is possible to make some crude estimates of the area

covered by the 50-year flood. These are based on (1) knowledge of the topography of the valley floor, (2) the location of the design flood inundation line, and (3) a small area study of the 50-year flood line at an industrial park site in the eastern end of the valley (9). The available data suggests that the 50-year flood will inundate 75% to 95% of the area which will be submerged by the design flood. Therefore, it is estimated that 3900 to 4900 acres of the valley floor will be inundated by the 50-year flood. Consequently, it appears that in the absence of flood protection agricultural activities within the valley can be expected to continue below the 50-year flood inundation level if water quality and soil salt problems can be economically resolved.

It is also difficult to predict future hydrologic occurrences. The difficulty arises from large uncertainties with regard to (1) pumping of the ground water on both sides of the border and (2) the occurrence of floods within the valley. If the exploitation of the ground water on both sides of the border exceeds the rate of recharge, then the level of the water table will drop and the ground water quality will deteriorate further. As the quality decreases, however, the extraction rate for agricultural purposes is also likely to decrease. Some reduction in the ground water produced for municipal supplies might also result from the increasing availability to the City of Tijuana of desalinized sea water, or reservoir water, which should become available upon termination of the present drought.

If the present drought persists, the deterioration of the quality of the ground water in the lower Tijuana River valley is very likely to continue. Under such circumstances, agricultural activities and soil reclamation projects might become totally dependent on imported water. If, on the other hand, extensive periods of normal rainfall recur, then marked improvements in the water quality and decreases in soil salinity can be expected. Certainly, the occurrence of a 10-year (16,000 cfs) flood every decade would greatly improve the ground water situation within the valley.

Consideration of Alternative Modes of Transportation

Although many highway planners pay lip service to the need to develop all modes of transportation, in the last analysis most highway EIS give short shrift to the mass transit alternative. Such is the case in the quotation printed below. Despite the fact that a substantial proportion of the traffic necessitating the construction of the proposed

highway is generated by workers commuting from out of town to their jobs at a Chrysler Corporation automobile plant, no attention has been paid to the possibility of bussing these people and diminishing the load in that manner. Yet such a move might result in substantial savings by allowing the project to be scaled down in scope.

Moreover, having eliminated mass transit as an "alternative," there is no mention of the subject in the chapter on "The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." Yet, given this country's excessive energy consumption and a burgeoning energy shortage, this is a long-term alternative which should have been investigated.

> At the present time and for the near future, automobile transport is the most feasible transportation mode to satisfy the requirements of the ... area.

The excerpt printed below, taken from the FEIS for a highway, is a slight improvement over the previous example in that this writer has looked at other forms of transportation and indicated the current status of each. He does not, however, carry his analysis far enough. The emphasis is on trucking and recreational travel. Missing is any consideration of long-term economic trends in the region and how they might alter the present transport picture.

The writer's reasoning here is hard to fathom, for further on in the EIS in the section on short term advantages of the project versus long term outlook he notes both the growing importance of the Uintah Basin as an oil and mineral producing region and the likelihood of additional growth there spurred by water storage and power generation facilities to be developed on Basin streams tributary to the Colorado River. Indeed, if matters go as expected, and the current energy and mineral shortages make it seem likely that they will, the resulting growth should have a substantial impact on the present transport mix in the Basin. Thus the writer should have explored such questions as: 1) Are increased pumping of oil and the mining of oil shale likely to cause revival of plans for construction of a railroad in the Basin? 2) If the answer is yes, how much traffic is likely to be diverted from the highway? Will this leave

the facility under-utilized? 3) If the answer is no, will it mean more traffic on the road, perhaps exceeding the level for which it was designed? 4) What are the alternatives for exporting the high wax content oils during the winter when they cannot be pumped through a conventional pipeline? Highway? Rail? Heated Pipeline? What would be the likely impact of each mode on the proposed project? 5) What type of development is likely to come in once the water storage and power generation facilities are completed? 6) How much traffic will it generate, and what type of traffic?

Obviously no polished analysis can be expected here, but the economic trends are clear enough that interviews with those developing the Basin's mineral and water resources should yield tentative answers about the future transportation mix. Possible tradeoffs among alternative modes of transportation, and the cost relationships involved could then be explored, and the proposed project seen in light of the total Basin transport picture rather than as a separate entity.

Note also that this discussion was not placed under the category of alternatives in the EIS, but rather under the physical impact of the project where it seems completely out of place.

PART II

C - Physical Impact of the Project

Other Modes	There is no planned expansion of other transportation routes or facilities. Proposals for construction of a railroad into the Uintah Basin have been shelved and oil is carried by pipeline. The newer oil fields in Duchesne County, however, are producing oils with a high wax content which cannot be pumped through the pipeline during colder winter temperatures. Vernal has a full-service airport with a paved runway which accommodates small to medium sized aircraft and scheduled flights by Frontier Airlines. Duchesne and Roosevelt have landing strips which do not have full-service. Air service, though, cannot replace the highway in supplying all transportation needs of the Uintah Basin. Future transportation needs appear to be oriented towards trucking and recreational travel.

C. Probable Environmental Impacts of the Proposed Project

This section is given over to an analysis of, and commentary on, probable environmental impacts. Two categories in particular concern us. First are the commonly encountered impacts such as air pollution where so much technical material is available that it becomes difficult for the EIS writer to isolate and interpret that portion which pertains to a particular project. Second are the less commonly discussed effects such as sociological impact or the impact of motor vehicle vibrations. Here the EIS writer may be confronted by a paucity of adequate data, a lack of familiarity with source materials, and/or uncertainty as to how to proceed in an unfamiliar area.

It is not the intent of this section to provide a comprehensive analysis of a broad range of impacts. Rather, those discussed are a selection chosen either because they are good illustrations of ways of handling the problems that arise in dealing with certain types of impacts, or because the particular topic merits more discussion than it currently receives in a typical EIS.

Air Pollution

Air pollution is a difficult subject with which to deal. We have already noted, for example, the sheer mass of available technical information and the difficulty it creates in the isolation and interpretation of that material which is pertinent to a given project. A further problem arises because EIS writers are generally uncertain as to what level and in what detail the matter should be pursued in the statement. Under these circumstances it is not surprising that a degree of confusion marks the discussion of this impact in not a few EIS.

In the case of highway EIS most writers have limited themselves to summarizing the levels of major pollutants emitted from automobile exhaust (CO, NO_x, HC), their concentrations along the route, and the comparison of these levels with Federal air quality standards. Some writers, particularly those whose projects are in areas with high background levels of pollution, have chosen to go a bit further and look at the amounts of other pollutants stemming from automobile exhaust, such as sulfur, lead and particulate matter, again relating these to Federal air quality standards. Few, however,

have attempted to relate emission levels to the pollutant priority ratings of the air quality regions in which the projects are being undertaken, something we consider highly desirable.

Under regulations promulgated by the Department of Health, Education and Welfare, each state is divided into a number of Air Quality Control Regions. There are eleven in Illinois. Sampling stations have been established in each region to monitor air quality on a continuing basis. Their initial task was to determine the region's background pollution levels for major air pollutants and to compare these levels with Federal air quality standards to see whether, or in what areas, a given region's air quality was threatened. Depending on the extent of the threat, priorities have been assigned to each region. These require special monitoring for those pollutants whose level approaches or exceeds the permissible standards.

In metropolitan areas, where background pollution is liable to be high and a new freeway may contribute substantially to the atmospheric pollution load, several levels of analysis are thus necessary. First, the impact of the project on the area it traverses needs to be assessed--a useful tool here is a contour map showing the expected concentrations of a pollutant as one moves away from the road (see example). This visual approach to the presentation of the data makes the extent of the impact much clearer than do statements such as "...the Carbon Monoxide (CO) and Hydro-Carbon (HC) concentrations 500 meters downwind will be 0.0027 parts per million (ppm) and 0.0004 ppm, respectively." Second, the contribution of the project to the regional background pollution load requires discussion, since it is a crucial factor in determining dispersion rates for pollutants. Both analyses would also benefit from the inclusion of a summary of prevailing meteorological conditions in the area.

One other point also deserves mention. A prominent feature in highway construction today is the bypass, routing traffic around cities and towns instead of through them. Justification for these projects usually includes a lowering of air pollution levels in these municipalities, but the expected positive impact is almost never documented. It would be desirable to have some predictions on this matter, and to follow up on these projects several years after they go into operation to determine how accurate the predictions were.

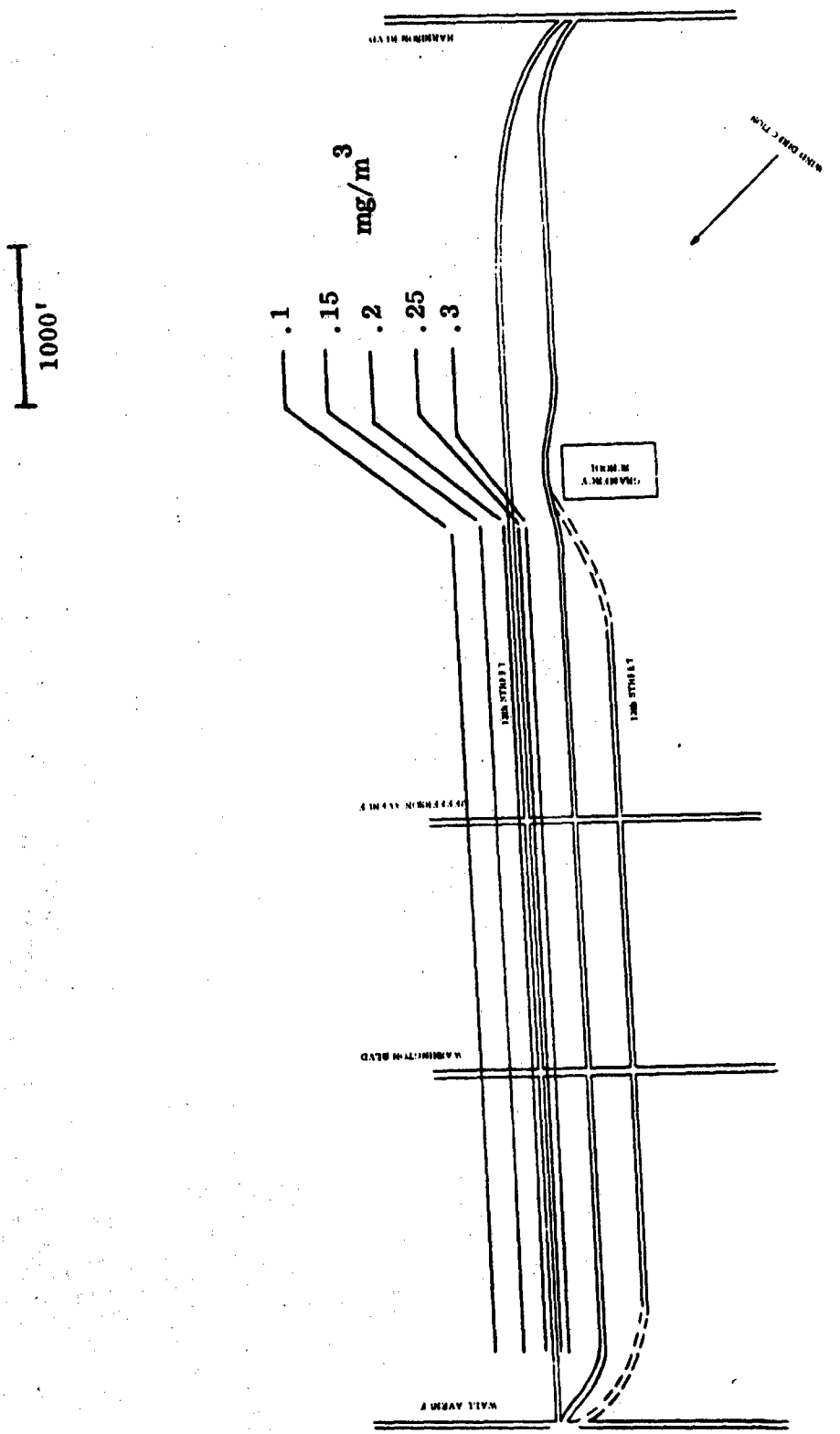


Figure 2-2. Added CO (Over 1970 Levels) for 1990, Alternate D, Peak Hour

Source: Hogan, C. M., L. Patmore, & H. Seidman, Environmental Impact Analysis for the 12th Street Corridor, Ogden, Utah, Environmental Systems Laboratory, Sunnyvale, California, 1972, p. 2-5.

In the following citation the EIS writers have attempted to assess the probable environmental impact of air pollution resulting from the construction of a highway bypass. Their method involved calculating the total amounts of CO, NO_x, and HC emissions likely to be generated by traffic using the route two years after its completion (1978) and in the project's design year (1995). Estimates were developed on the basis of uncontrolled emissions and using the 1975 and 1976 federal standards for new vehicle emissions. From these figures the authors concluded that "...the average air quality from vehicle exhaust emissions along the ... Bypass will not be a significant adverse effect on a substantial number of people."

This conclusion does not seem warranted by the analysis. There are far too many avenues which still require exploration before the air pollution impact can be pinned down one way or the other. First, and most important, the authors have failed to relate their figures to the background level of pollution for the surrounding region. This highway is to be constructed just eight miles downwind of a major industrial city which generates substantial amounts of pollution. It is likely that because of these emissions the ambient air in the region contains nearly the maximum permissible amounts of one or more of the major pollutants. This means that to adequately evaluate the project's effect one must first ascertain the maximum permissible levels for the major pollutants as established by the local Air Quality Control Region, as well as the current background levels of these pollutants. Only then can one determine impact, i.e., whether the pollution load from the proposed project, added to the background figures, will substantially affect existing air quality.

Second, the authors limit their discussion to the three major pollutants in automobile exhausts. In some cases this may be sufficient, but in industrial areas such as this where background levels of pollution are likely to be high, the amounts and effects of other pollutants from automobile exhausts, such as lead, sulfur, and particulate matter, generally warrant calculation and evaluation.

Third, the analysis does not delve into such project related effects as concentrations of pollutants in the vicinity of the highway, or their impact on those who will be living near the facility. To accomplish this latter end, the writers would have had to determine probable future land use patterns, a subject they explicitly duck with the less than convincing explanation that "...future development is the responsibility of local agencies through zoning of land, which the Illinois Department of Transportation has no control over." Alternatively, they could have used their calculations as the basis for a set of contour maps showing the expected concentrations of each pollutant as one moves away from the highway. These in turn could have been consulted to determine the likely effect of automobile emissions on any future land use. Unfortunately, neither alternative was considered.

Fourth, the writers indicate but do not document an expected drop in air pollution levels in the downtown area once the bypass begins to divert traffic away from it. As this lessening of impact is one of the chief rationales for the project, estimates of the degree of improvement should have been developed.

Fifth and finally, in light of the conditions in this airshed noted above--particularly the contiguous location of the two major centers of population--a discussion of the meteorological conditions in the area would be desirable. This should include such items as wind speed, wind direction, topography, frequency of inversions, etc.

> At the present time no air quality standards relating to highway improvements have been issued by the Federal Highway Administration.
>
> In the absence of such standards or criteria, qualitative estimates based on quanitative data available from the U.S. Environmental Protection Agency and the U.S. Department of Health Education and Welfare relating to vehicle emissions can be developed.
>
> The quantitative data can be developed with existing as well as projected traffic volumes. The projected traffic, two years after construction and projected traffic for the design year is our best estimate based on proposed development plans for .... The future development is the responsibility of local agencies through zoning of land, which

the Illinois Department of Transportation has no control over. The ... Bypass is designed with the most current future development information available at this time.

Qualitative

For a general view of air quality, which the following quantitative data will support, it can be stated that:

> "Federal standards for new vehicles will cause a decrease in HC and CO emissions beyond 1980 in spite of the increase in vehicle population. Nitrogen oxide emissions, however, will continue to increase at a rate augmented by efforts to control CO and HC emissions, unless NO_x emissions are specifically controlled."[1]

The above statement was made based on standards for emissions established through 1971. Since then specific actions, through issuance of standards through 1976, have been taken in regard to NO_x emissions.[2] These standards provide that NO_x emissions will also be reduced even though vehicle population increases.

Quantitative Analysis of Air Pollution Emissions:

Typical uncontrolled vehicle emission for exhaust (per 1968) on a mass basis are:[3]

H_xC_y - 8.9 grams/vehicle - mile

CO - 44.5 grams/vehicle - mile

NO_x - 5.3 grams/vehicle - mile

This data is used in calculating the probable effect the bypass would induce if there were no Federal standards for vehicles.

---

1. Control Techniques for Carbon Monoxide, Nitrogen Oxide, and Hydrocarbon Emissions from Mobile Sources, U.S. Dept. Health, Education & Welfare, (Washington, D.C.: National Air Pollution Control Administration, 1970). Publication No. AP-66, p. XV.

2. Federal Register; Volume 36, Number 128, Friday, July 2, 1971, Part II; (Title 45, Chapter XII, Part 1201.21), p. 12658.

3. Op. Cit., H.E.W., Publication No. AP-66, p. 3-8.

The established exhaust vehicle emission standards on a mass basis are:[4]

[5]

	1975	1976
H_xC_y	- 0.4	0.4 grams/vehicle - mile
CO	- 3.4	3.4 grams/vehicle - mile
NO_x	- 3.0	0.4 grams/vehicle - mile

... Bypass Data:

Length - 5.5 miles (approximately, between established termini)

Traffic[6] - 11,284 vehicles, 1978 ADT, two years after construction of the bypass.

- 16,120 vehicles, 1994 ADT, design year.

CALCULATIONS:[7]

2-Years After Completion

N x 1,000 Average grams/day	1978 A.D.T. Uncontrolled Emissions	1978 A.D.T. 1975 Standards	1978 A.D.T. 1976 Standards
H_xC_y	552.4	24.8	24.8
CO	2761.8	211.1	211.1
NO_x	329.1	186.3[8]	24.8[8]

4. Op. Cit., Federal Register; Volume 36, Number 128, p. 12658.

5. Op. Cit., H.E.W., Publication No. AP-66, p. XV.

6. A.D.T. used here is the largest average vehicles per day projected, and used to indicate the worst traffic condition anticipated for any single segment.

7. (Average grams/day) N = (A.D.T.) x (miles of freeway) x (emission standard for HC, CO or NO)

Design Year

N x 1,000 Average grams/day	1995 A.D.T Uncontrolled Emissions	1995 A.D.T. 1975 Standards	1995 A.D.T. 1976 Standards
H_xC_y	789.1	35.5	35.5
CO	3945.4	301.5	301.5
NO_x	469.9	266.0[8]	35.5[8]

CONCLUSIONS

From the average calculations it is evident that the average air quality from vehicle exhaust emissions along the ... Bypass will not be a significant adverse effect on a substantial number of people.

Further, summary data (Table 8-1) on projected vehicle exhaust emissions supports the average calculations.[9]

It is apparent that a net reduction in air pollution from the ... Bypass will be felt by a substantial number of people in the area. Alternatively, a relatively fewer number of residents in close proximity to the bypass might be faced with increased air pollution problems, but the increase is considered insignificant.

---

8. Op. cit., H.E.W. Publication No. AP-66, p. XV.

9. Op. cit., H.E.W. Publication No. AP-66, p. 8-2.

One of the best general discussions of the impact of automobile emissions is in the FEIS for the East Mason Street Project from South Jackson Street to Bellevue Street in Green Bay, Wisconsin (see below). The committee which produced this report seems to have intended that it contain background material on each impact discussed for the benefit of the reviewers,

who in this case would be laymen. (For details on the origin of the East Mason Street Project FEIS see the commentary under noise impact). Thus this section begins with a review of the characteristics of HC, NO_x, CO, SO_2 and SO_3, particulate matter, and lead, their relation to the internal combustion engine, and their respective effects on vegetation and, most important, on human health. Only then do the writers get around to the specific case in question.

The inclusion of background material on impacts is, in our opinion, an excellent idea which deserves wider adoption. Particularly where a project is controversial, the EIS has the potential to become more than just a document written to comply with federal law. It can also perform a valuable function by informing the concerned citizen about a proposed action and its anticipated impact. The problem is that many impacts are highly involved and the layman lacks the technical expertise necessary to grasp them. For this reason it is highly desirable to include sufficient background material so that the citizen reader can see the full ramifications of the project. In this respect the East Mason Street Project FEIS deserves high marks.

Unfortunately, when the analysis finally focuses on East Mason Street itself the caliber of the discussion deteriorates appreciably. First, while attention has been given to prevailing meteorological conditions in the discussion, the only variables referred to are mean wind speed and wind direction. Because atmospheric conditions change appreciably from season to season, and correspondingly the ability of the atmosphere to absorb or disperse pollutants, a seasonal analysis would be more meaningful. Second, East Mason Street is tree-lined; yet there is no discussion of the effects of automobile

emissions, present or future, on this vegetation. Third, the calculations used to generate chart 3, "Estimated Automobile Produced Pollutants Vs. Standards," are such as to raise questions about the chart's validity. To begin with, rather than assessing each alternative separately, the writers have presented generalized neighborhood data, apparently basing their measurements on the present road alignment. Yet one of the alternatives is for rear access to the properties along East Mason Street, thus placing these homes adjacent to two sources of pollution, rather than one. Further, the calculations of maximum emissions "assume a distance of 22 feet from the source to the point of interest." Yet, at least one of the alternatives would bring the road closer to the homes than this. We believe an analysis of each of the alternatives individually, with the data presented as contour maps showing the concentrations of each pollutant away from the road's midline, would have alleviated the problems just cited and enabled one to have more confidence in this section's stated conclusion that "the addition of automobile produced emissions to the air of East Mason Street would not have a significant impact on human health if the street was widened."

To close on a positive note, this excerpt contains the only attempt we found to relate the estimated pollution from a project to the background levels of pollution for the regional air shed. This type of analysis should become standard procedure in all EIS where it appears that the project might contribute substantially to a deterioration of prevailing air quality.

(Note:

The citation has been abridged to conserve space. The deleted material dealt with the major pollutants from automobile exhausts (CO, NO_x, HC). Our feeling was that sufficient information is available concerning their characteristics and effects elsewhere that no serious harm resulted to the citation from their omission.)

IMPACT OF AUTOMOBILE EMISSIONS

Present day transportation modes, and particularly the motor vehicle, emit many forms of air pollutants. The primary pollutants emitted are hydrocarbons, oxides of nitrogen, carbon monoxide, oxides of sulfur, particulate matter, and lead.

The transportation sources and characteristics of these pollutants are:[1]

*** ***

Oxides of Sulfur

Transportation Sources: The motor vehicle supplies less than 10 percent of the total sulfur oxides in the atmosphere.

Characteristics: Sulfur dioxide (SO_2) is the main oxide of concern, due to its toxic nature even at low concentrations. Sulfur trioxide (SO_3) combines with water vapor in the air to form sulfuric acid, which is a stronger irritant than SO_2, and a strong corrosive agent. Sulfur trioxide is less prevalent than sulfur dioxide.

Particulate Matter

Transportation Sources: The chief sources of particulate matter (organic and inorganic) are industrial operations, modern transportation facilities, and domestic combustion processes.

Transportation facilities or vehicles contribute small amounts of particulates on an individual basis, but when the combined effect of all transportation vehicles' emissions are considered, significant particulate loads are deposited into the atmosphere.

Characteristics: Suspended particulate matter ranges in size from 10 microns (1/1000 of a millimeter) in diameter, to 0.1 microns or smaller, and may be liquid or solid.

The most frequent metallic elements associated with airborne particles are silicon, calcium, aluminum, iron, magnesium, lead, copper, zinc, sodium, and manganese. The organic fraction of particles is usually even more complex, and may contain a large number of aliphatic and aromatic hydrocarbons, acids, bases, phenols, and many other compounds.

Lead

Transportation Sources: The automobile is the single greatest source of lead pollution in the atmosphere (approximately 15 percent). This is because of the tetraethyl lead added to gasoline to improve engine performance.

Characteristics: Lead is toxic at certain concentrations, and the major concern with this pollutant is its cumulative effect in the body. To date, these levels have not been found to exceed acceptable limits.

The health effects (and other effects, where applicable) of these individual air pollutants are:[2]

*** ***

Oxides of Sulfur

Sulfur dioxide (SO_2) is one of the most abundant air pollutants, and one of the easiest to measure. It is often taken as a general indicator of air pollution buildup. SO_2 in automobile emission is not very important, however, especially in locations where a lot of SO_2 is produced by heating sources and thermal generators. There is relatively little sulfur in automotive fuels.

As a pure dry gas, SO_2 is not harmful even at 5 ppm. 5 ppm would, though, be an extremely high concentration in polluted air when mixed with particulates and fog (moisture). In the "Great London Smog" of 1952, SO_2 concentrations did not exceed 1.3 ppm. It appears that the health effects of polluted air are due not to SO_2 as such, but to the other pollutants which accompany SO_2.

There is good evidence that bronchial asthma, chronic bronchitis, emphysema and lung cancer are aggravated by air pollution. These diseases are approximately twice as common among city dwellers as among country dwellers. Sulfur dioxide, particulates, and moisture are generally considered to affect health as follows:

The SO_2 and moisture combine to form sulfurous and sulfuric acids.[2] These adhere to particles of carbon which are carried into the lungs and cause damage on contact with the lung tissue.

Other Effects: Sulfur dioxide causes both acute and chronic injury to the leaves of plants. Acute injury occurs at concentrations of about 0.25 ppm, with the severity dependent upon the concentrations and length of exposure. Long term exposure to atmospheric sulfur dioxide results in leaf injuries, reduced growth, and tree mortality.

Sulfur dioxide and sulfuric acid are responsible for the accelerated corrosion of metals such as iron, steel, copper, and nickel. Sulfur dioxide and sulfur trioxide attack building materials which contain carbonates (limestone, marble, slate, and mortar). These materials are converted to relatively soluble sulfates and are leached away by water. Oxides also make paper brittle, and harm synthetic fibers used in textiles.

Particulate Matter

Studies of epidemics indicate an association between air pollution and health effects of varying severity. This association is most firm for short term air pollution episodes. Healthy persons are generally not affected by long term concentrations as high as 200 to 300 ug/m^3, but persons with asthma or other respiratory diseases may be affected (respiratory distress).

Health effects of particulate matter are determined by chemical composition and size. Particles larger than 10 microns in diameter generally do not enter the respiratory system at all. Particles larger than 5 microns in diameter enter the upper respiratory tract, affecting nose and throat, but are not drawn into the lungs. Particles less than 5 microns in diameter enter the lungs and can carry acid with them.

Other Effects: Particles suspended in the air scatter and absorb sunlight, reducing the amount of solar energy reaching the earth, and producing hazes and reducing visibility. Visibility reductions occur at concentrations of particulate matter below those considered to be of health importance.

The range of visibility may be estimated approximately from the following formula:

$$\text{Visibility (in miles)} = 750 \,/\, \text{Particle Concentration expressed in } ug/m^3$$

A visibility range of less than five miles interferes with aircraft operations and it may be seen that this occurs at a particle concentration of 150 ug/m^3.

Particulate matter damages textiles and buildings by soiling, and it appears to intensify the corrosion of metals, especially in combination with pollutant gases of acidic nature.

Particulate matter in diesel and gasoline engine exhausts is also a source of offensive odors.

Lead

The health effects of airborne lead are somewhat controversial. Lead is known to be a poison, and it is cumulative in the body. No one has contracted lead poisoning from breathing polluted air, however; 90 percent of all lead taken into the body comes from food and water.

The automotive contribution to lead in the air is about 15 percent. It has not been shown to be a health hazard, although it is true that city dwellers generally have higher levels of lead in the blood than country dwellers. The argument for removing lead from gasoline is not that it is presently a health hazard, but that it potentially is, since lead concentrations are on the increase almost everywhere.

The level of lead in the blood is transient and is an indicator of current exposure. Lead accumulates in the bones. Under metabolic stress, stored lead is mobilized. It is reported that lead in the blood stream may interfere with maturation and development of red blood cells, cause disturbance of enzyme activity, and interfere with some liver and kidney functions. Lead intoxication occurs above 0.09 mg of lead per 100 grams of blood.

Other Effects: A relationship exists between the amount of lead in the air and traffic volume, proximity to highways, engine acceleration, and wind direction. It has been found that the effect of traffic on lead levels in the air is limited to a rather narrow zone bordering the lee side of the highway. Effects on humans have not been detected.

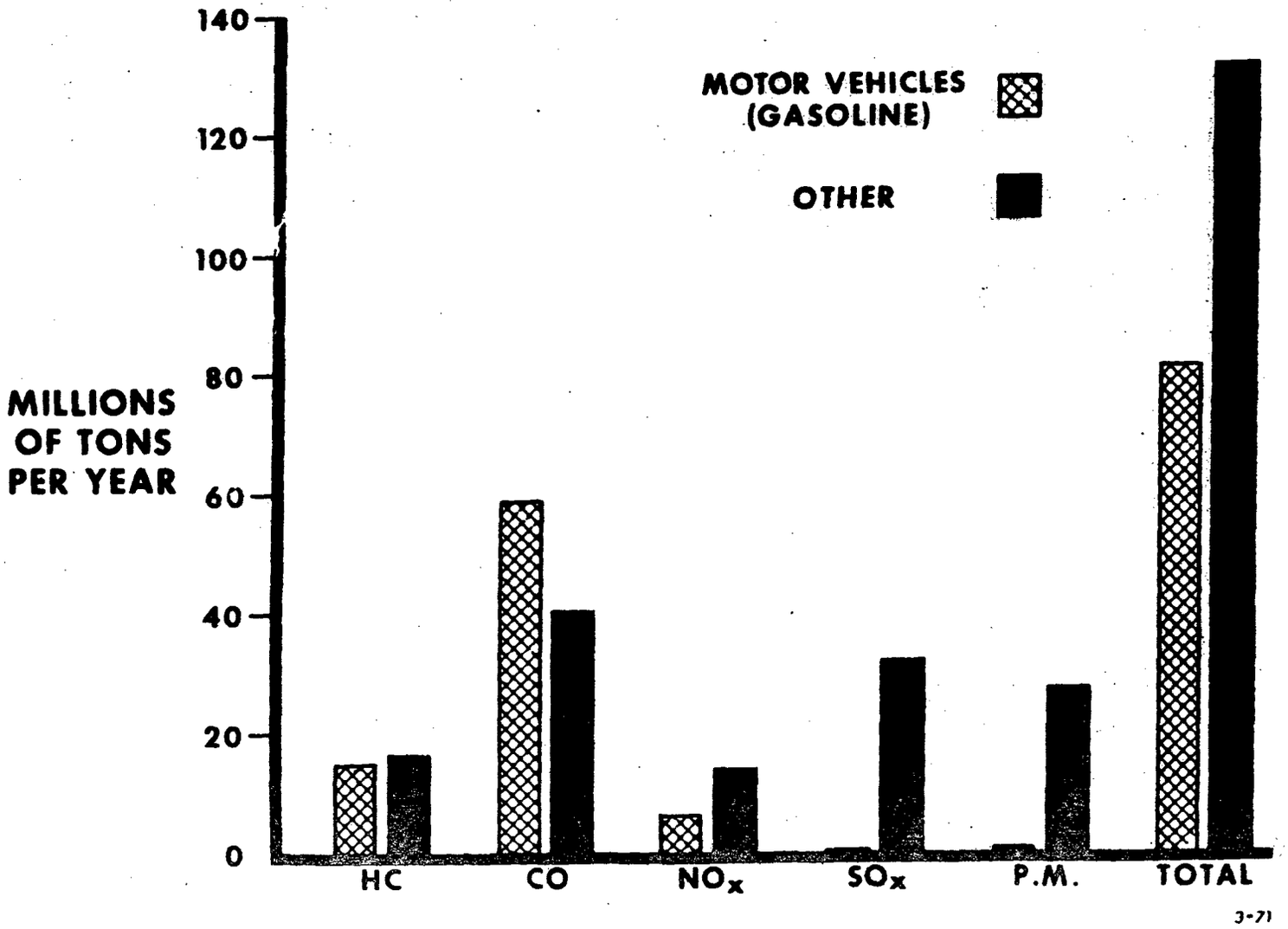
Lead in automotive fuels interferes with the operation of catalytic mufflers, which are designed to decrease automotive emissions of hydrocarbons and carbon monoxide.

The bar chart (See chart 1) shows the automobile portion of each of the major air pollutants originally identified by HEW.[3]

CHART 1

U.S. AIR POLLUTION ON A WEIGHT BASIS

FEDERAL DATA FOR 1968



3-71

The chart includes hydrocarbons, carbon monoxide, oxides of nitrogen, sulfur oxides and particulate matter of dust. As can be seen from this chart, about half of all hydrocarbons come from automobiles, and the other half comes from other sources. The automobile is responsible for a little over 60 percent of the total carbon monoxide in the U.S. atmosphere. About two-fifths of the oxides of nitrogen emissions come from automotive sources. Note, however, the relatively low contribution of automobiles to both the sulfur oxides and particulate matter levels.

The pair of bars on the far right represent the tonnages of all air pollutants.

Automobiles in 1968 were responsible for about 39 percent of the tonnage of pollutants in the atmosphere. This figure is the one most often cited as indicative of the automotive contribution to the overall air pollution problem. This figure has been as high as 90 percent in some statements, but more often 60 percent is the figure used. The data on this bar chart is from the most recent HEW publication (August, 1970). HEW previously published information which showed a 60 percent figure for 1966 and which probably serves as the basis for the above-mentioned statements.

The use of such data assumes that a ton of hydrocarbons is as much of an air pollution problem as a ton of carbon monoxide or a ton of sulfur oxides. This is simply not the case. According to the latest proposed air standards, it takes over 100 tons of carbon monoxide to be of as much air pollution concern as one ton of sulfur oxide. If both the total tonnage and these air pollution concern issues are considered, then a "relative-effect" bar chart can be drawn (See Chart 2). This shows that the automobile is responsible for less than 10 percent of the total U.S. air pollution problem for the 1968 calendar year. The automobile certainly should be less responsible than that for air pollution today because of the increasing control systems installed nationally since 1963, and particularly because of the exhaust control added with 1968 models.

At the symposium on "Lead in Gasoline", it was concluded that there have been no known cases of illness or death to animals or man traceable to lead particules from automobile exhausts. With the development of low-leaded and unleaded fuels, and the increased use of these fuels, this pollutant will decrease with time.

Chart 3 shows the estimated contribution of automobile-produced pollutants to the regional air quality. These computations are based upon calculations given in the "Workbook of Atmosphere Dispersion Estimates," a publication of the U.S. Department of Health, Education and Welfare.

CHART 2

U.S. AIR POLLUTION ON A RELATIVE EFFECT BASIS

POLLUTANT WEIGHTS ADJUSTED TO SAME EFFECT LEVEL AS FOR PARTICULATE MATTER

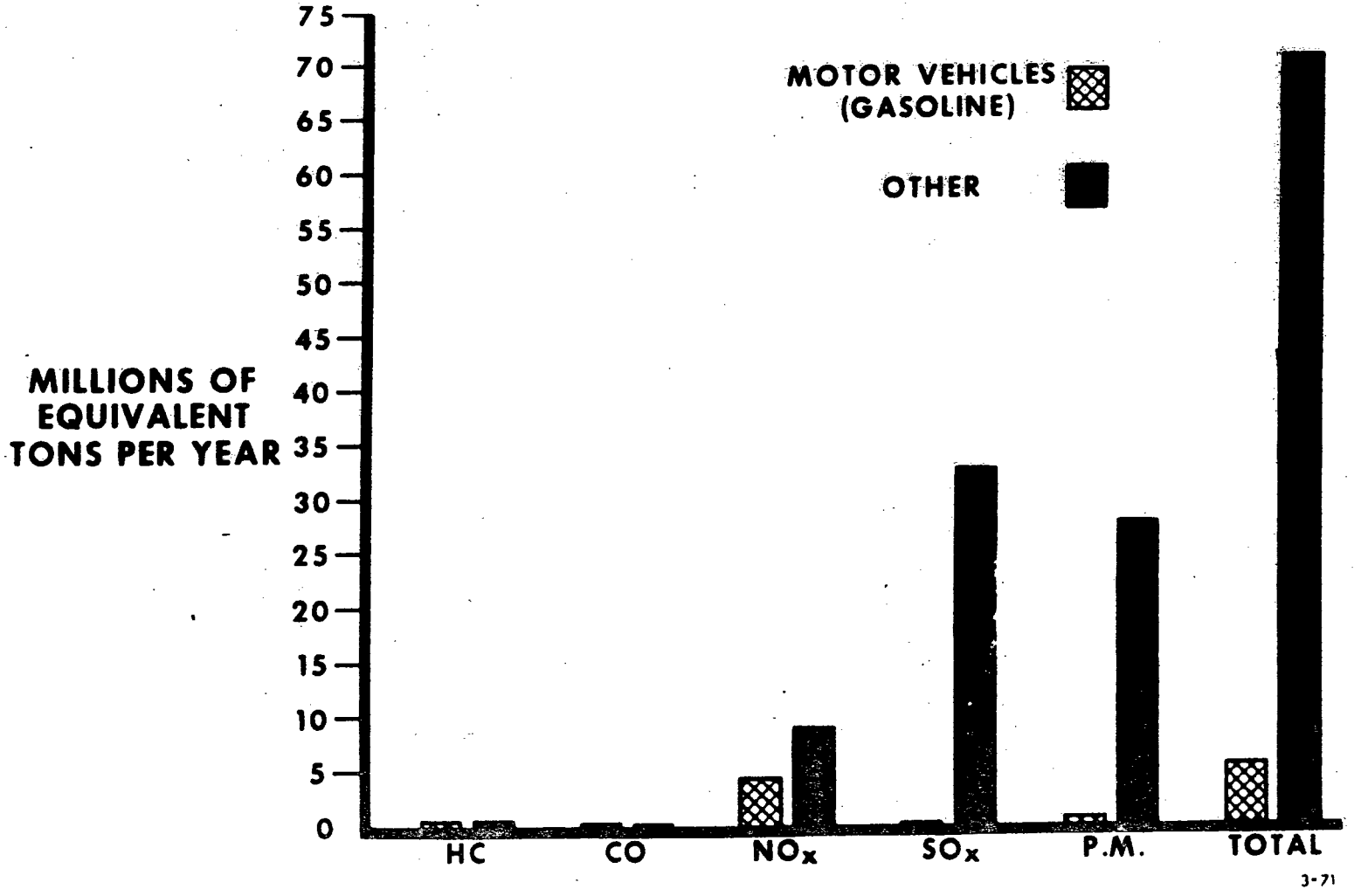


CHART 3

ESTIMATED AUTOMOBILE PRODUCED POLLUTANTS VS. STANDARDS

Pollutant	Measurement	Maximum ≠ Estimated Contribution 1973	Maximum ≠ Estimated Contribution 1993	Air Quality Standard#	
Hydro-carbons*	ug/m^3	62	5	160.0	3 hr/ concentration (6 to 9 A.M.)
Carbon Monoxide*	PPM	1.53	0.08	9.0	8 hr/ concentration
Nitrogen Dioxides*	PPM	0.0499	0.0082	0.05	Annual Mean concentration
Oxides of Sulfur	PPM	0.0026	0.0042	0.03	Annual Mean concentration
Partic-ulates	ug/m^3	9.5	15.1	75.0	Annual Mean concentration

Current primary ambient air quality standards (April 30, 1971 Federal Register). Equals Wisconsin Standards Wis. Adm. Code Section NR 155.

* Automobile mix by age according to 1960 "Automobile Facts and Figures". Based upon 1975 legislated controls and no cars 19 years of age.

≠ Based upon a distance of 22 feet from the source to point of interest and a 10.2 mph mean wind speed.

The computations in Chart 3 are based upon the maximum 1973 and 1993 projected Average Daily Traffic (ADT) volumes. Actual traffic counts taken on East Mason Street were used to determine the percentages of the ADT for use in the computations.

The computations are also based on the mean wind speed and direction from data available at the U.S. Weather Bureau, Austin Straubel Airport. WFRV-TV, Channel 5, is located on East Mason Street and would have been a better source of wind speed and direction figures, but its forecasting service relies on U.S. Weather Bureau information. The mean wind speed is 10.2 mph. The wind comes from a southwest direction. Changes in the wind speed affects the calculated contributions inversely.

The computations assume a distance of 22 feet from the source to the point of interest. Distance affects the computations inversely (i.e., the calculated level decreases with a greater distance.)

The values in Chart 3 are for the maximum ADT on East Mason Street. For any other traffic volume, the estimated contribution of any pollutant to the quality of this region's air would be proportionately less.

In 1973, the most significant pollutant contribution from vehicles using East Mason Street will be nitrogen dioxides. The estimated contribution of this pollutant is equal to the Air Quality Standard. It must be noted that this contribution is estimated at only 22 feet from the source to the point of interest and that any distance increase will reduce this value.

The other pollutants listed contribute from 9 to 39 percent toward the Air Quality Standard level.

Under 1993 controls, the contribution of all pollutants will range from 1 to 20 percent of the Air Quality Standards. The most significant reduction to be realized will be nitrogen dioxide from equal to the Standards down to 16.4 percent of the Standards.

Green Bay is located in the Lake Michigan Interstate Air Quality Region. This region has a Priority III rating for all pollutants except particulates for which it has a Priority II rating. With these priority ratings, the only pollutants that must be monitored in accordance with the 1970 Federal Clean Air Act are sulfur dioxide and particulates.

These two pollutants have been monitored in Green Bay. Particulates monitored at 100 N. Jefferson Street, City Hall, in 1972 showed a geometric mean of 43.40 ug/m^3. With the 1973

contribution estimated at 9.5 ug/m^3, a total geometric mean of 52.9 ug/m^3 results, which is below the air quality standard of 75 ug/m^3.

At this same location, the sulfur dioxide monitored for the same time period was found to be at a level of 22.43 (0.0082 ppm). This 0.0082 ppm plus the 1973 contribution of 0.0026 ppm results in a total level of 0.0106 ppm which is below the air quality standard of 0.03 ppm.

Many people express concern over the probable levels of various pollutants along East Mason Street. One pollutant that seems of particular interest to many is carbon monoxide, possibly because of the deaths attributed to it. Chart 4 represents the estimated 1973 and 1993 contribution levels as the distance downwind from the source increases. In 1973, the 1.5 ppm contributed to the quality of this region's air at 22 feet from the roadway decreases very fast as the distance from the source increases. At the back lot line (approximately 240 feet from the source) the estimated contribution is 0.19 ppm (2 percent of the Air Quality Standard). In 1993 the estimated contribution to the regional air quality is 0.08 ppm (1.0 percent) at 22 feet and is less than 0.01 ppm at a distance of 240 feet.

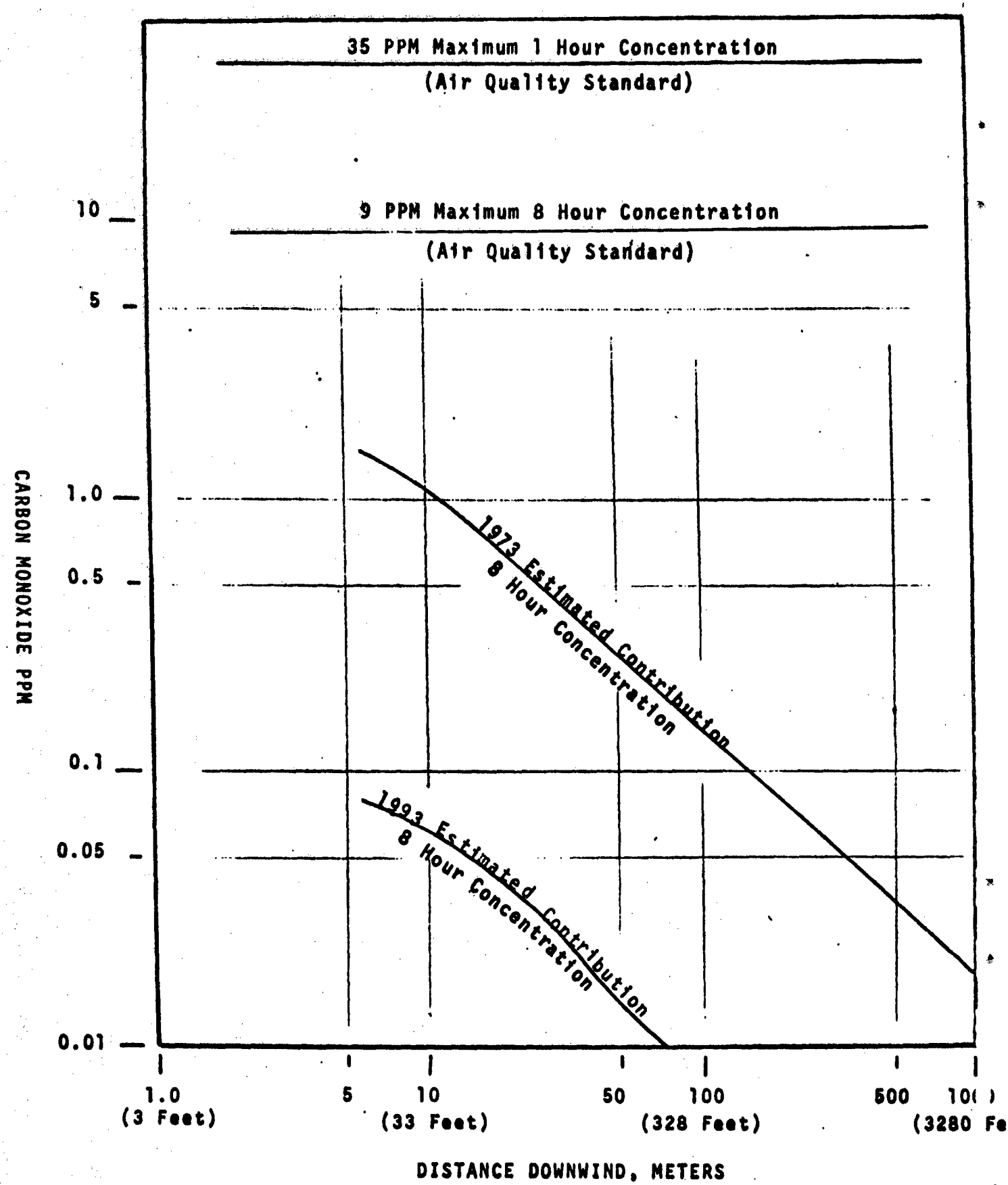
Chart 5, "Carbon Monoxide Effects", shows the relationship between human health effects and the exposure time at various levels of carbon monoxide concentration. Note that the maximum one hour concentration of 35 ppm is in the area below that where symptoms develop and is a very conservative level. Also shown is the maximum eight hour concentration of 9 ppm and the estimated 1973 concentration on the front of a house along East Mason Street.

Conclusion

The addition of automobile-produced emissions to the air of East Mason Street would not have a significant impact on human health if the street was widened. The 1973 traffic volumes on East Mason Street will be the same whether this project is constructed or not. With no change in traffic volumes during 1973, no change in the environmental effects from automobile emissions is anticipated. The air quality of the area should improve in the future because of the emission controls on automobiles being enforced, and because of the Wisconsin Department of Natural Resources general air control policies.

CHART 4

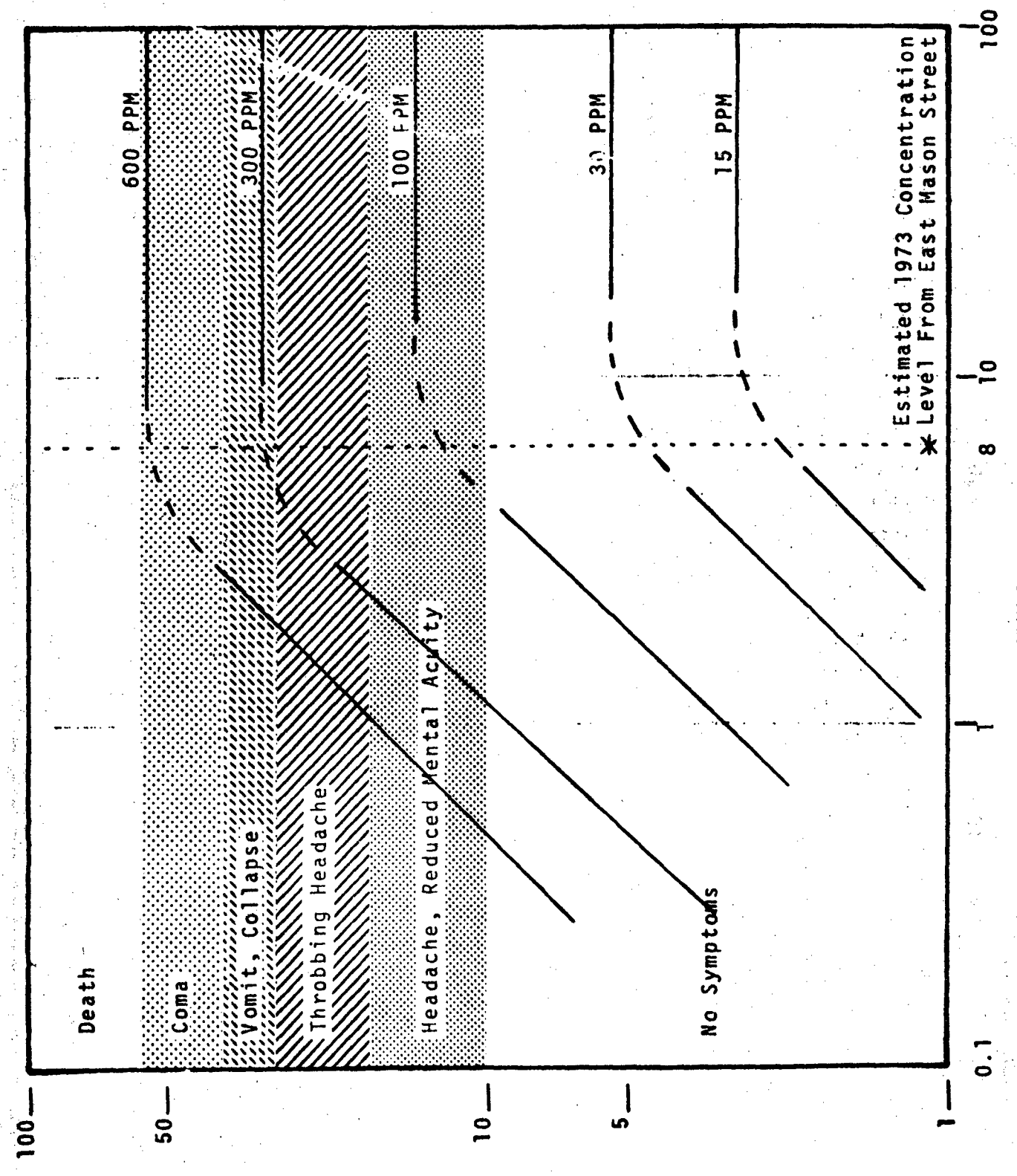
EAST MASON STREET ESTIMATED CARBON MONOXIDE CONTRIBUTION AS A FUNCTION OF DOWNWIND DISTANCE FROM THE SOURCE



CARBON MONOXIDE EFFECTS

Chart 5

Source: Seen Course
Environmental Problems-Proposed Solutions
By Dr. Phillip S. Myers, P.E.
Professor Mechanical Engineering, Engineering Research
University of Wisconsin - Madison, Wisconsin



References

1 Report RR 169, "Transportation Air Pollution," Department of Highways, Ontario, Canada.

2 Ibid.

3 Fred W. Bowditch, Ph. D., "What's the Future for Automotive Emissions Controls?" Paper presented to 1971 Joint American Gas Association - Edison Electric Distribution Conference, Operation Section.

4 Symposium Proceedings, "Lead in Gasoline," Washington Academy of Sciences, Bethesda, Maryland, Summer, 1971.

5 Bruce D. Turner, "Workbook of Atmospheric Dispersion Estimates," U.S. Department of Health, Education, and Welfare, Revised, 1970.

Noise Pollution

Although less publicized than air and water pollution, noise pollution has in recent years become recognized as a serious problem, especially in urban areas. Its effects run the gamut from disturbance of speech and sleep to permanent hearing loss. Thus it is unfortunate that a lack of expertise in this field and uncertainty over the extent to which the matter should be pursued have resulted in generally lackluster discussions of noise impact in EIS to date.

To help clarify this issue, we are including two lengthy selections which are among the best discussions of the topic we have encountered. The first is taken from a DEIS for F.A.P. Route 410, Columbia to Carbondale, Illinois. This is a draft statement for a rural highway corridor and thus the discussion centers not on specifics of design, but on the current state of noise pollution regulation and on the variables that should be considered in predicting future noise levels in rural areas.

> Noise pollution regulations are scheduled to go into effect some time during 1972 to assure that traffic related noise

problems will be reduced to a minimum along those highway projects where the Federal government is participating in the cost of construction. In order to assure that noise is being given proper consideration during the route selection and design process, these new regulations require that noise sensitive zoned areas be identified, potential noise levels be determined based upon predicted traffic levels, and that various means of reducing the noise problem be evaluated as a part of the highway study process.

The Federal government has recognized that not all noise problems can be resolved by highway interests alone. While much of the problem can be minimized by locating highways through areas of low noise sensitivity and adopting certain design techniques to shield areas of high sensitivity from the noise source, other interests will be expected to participate in the resolution of the problem as well. The production of quieter vehicles, particularly trucks will aid substantially in the fight against highway noise. The maintenance and inspection of motor vehicles will also insure that the quietness built into new vehicles will remain intact. In addition to the vehicles themselves, much can be accomplished by intelligent zoning of land use by local zoning boards along existing and proposed highway corridors. It has long been recognized that certain land uses are more sensitive to noise problems than others--that sound levels that are acceptable in industrial areas are not necessarily acceptable in residential areas.

In the process of determining whether or not a potential noise problem exists along a given highway, the first step consists of cataloging the existing land uses within a highway corridor to determine the corridor's sensitivity to noise. The second step consists of predicting the noise level that will be reached at some future date if a given highway improvement is constructed. The following items are some of the variables which are used in the process of predicting future noise levels:

1. What is the total amount of traffic that passes a given point?

2. Is there a large percentage of truck traffic involved? (The sound from a single truck can equal the sound from 50 to 60 cars under certain conditions.)

3. At what speed does the traffic flow and is there a lot of congestion or "stop and go" traffic involved?

4. What will be the roughness of the pavement surface?

5. How wide is the highway facility and how many traffic lanes does it contain?

6. How far away from the highway is the person hearing the noise?

7. How steep are the vertical grades of the highways?

8. Does the topography that borders the highway tend to absorb and muffle the sound, or does it simply reflect the sound waves to give an echo effect?

When dealing with an exact highway location, it is possible to first catalog land use to either side of the highway centerline, and then to apply the above eight variables to determine projected noise levels at some future date in order to decide (a) whether there is a problem, and (b) if so, what steps can be taken to reduce noise levels to an acceptable range. When dealing with a 1 to 5 mile wide "corridor" instead of a "centerline" location, however, determining whether or not a problem exists and what can be done to resolve the problem would apparently result in a meaningless exercise of juggling figures and facts.

Noise from a highway effects a relatively narrow band--probably no wider than 1,000' in width. Beyond this band, the noise level will have dissipated to an acceptable level. As the highway centerline is shifted anywhere within the 5 mile width corridor, the area of influence will change a like amount. It is obvious that the distance from the noise source (the highway) to the observer will shift with each shift in centerline of the highway. With each shift in centerline, the topography that borders the highway will vary and alter the amount of sound that will be absorbed or reflected. And finally, with each shift in alignment, there is a corresponding change in the land use type to either side of the highway, which results in a revision of the amount of noise that can be tolerated (different land uses involve different tolerable noise levels or "goals"). Because of the infinite number of combinations of the variables involved, it becomes meaningless to compare one highway corridor against another.

By way of contrast, the second selection is taken from an FEIS for an urban road improvement, the East Mason Street Project from South Jackson Street to Bellevue Street in Green Bay, Wisconsin. This report outlines the basic properties of noise, its physiological and psychological effects, suggests guidelines for acceptable levels of noise, and details the methodology used and the results of a noise survey along East Mason Street. The noise parameters for alternative routings are also discussed. Several aspects of the Green Bay report deserve special mention. First, note the extensive literature search that was conducted prior to writing the chapter. This undertaking, designed to provide an overview of the subject at hand, is strongly recommended wherever the nature of the impact is not clear. Second, no conclusions are drawn and no recommendations made. All data are presented impartially so that the decision on which alternative to choose can be made independently. The benefits of this approach have been indicated in Chapter 2. The arm's length which the writers kept from the project, and from the emotion which surrounded it, contrasts sharply with not a few EIS which read as if they were prepared by a lobbyist.

Third, and last, this discussion is an excellent example of what can be done by a group of interested citizens. The East Mason Street Project was originally scheduled to be constructed with federal monies; thus in compliance with NEPA a DEIS was prepared by the City of Green Bay. This document provoked sufficient controversy that when, subsequently, federal funds for the project were withdrawn and the City decided to go it alone, the City Council agreed to fund the preparation of a FEIS by a committee of laymen. This was done even though such a report was not required by law. In ten weeks the East Mason Street Environmental Impact Committee put together a document which, while not without its flaws, is a very thorough and competent job.

IMPACT OF NOISE

Introduction

Noise is becoming recognized as one of the most serious forms of pollution in the urban environment (Bragdon, 1970; DOC, 1970; Kryter, 1970; Schultz, 1971). Noise can have a wide range of effects ranging from mild annoyance through disruption of speech and sleep and serious physiological arousal to permanent hearing loss (Kryter, 1970; Welch & Welch, 1970). The primary source of disruptive noise in the city is traffic (Chalupnik, 1970; DOT, 1972; Dowling, 1972) and, therefore, any proposed change in roadways must be seriously evaluated in terms of the noise impact on the area.

In the sections that follow, the likely noise impact of the various alternatives for reconstructing East Mason Street are considered after a discussion of:

(a) basic properties of noise,
(b) physiological and psychological effects of noise,
(c) suggested guidelines for acceptable levels of noise, and
(d) measured current levels of noise along East Mason Street.

Basic Properties of Noise

Since noise is commonly defined as unwanted sound, it has the properties characteristic of sound. The usual source of sound is a vibrating surface generating waves of compression and expansion in air. Two important properties of these waves are the frequency (the number of waves per second or Hz), which determines the pitch of the sound, (e.g. low frequencies have a low pitch) and the intensity or amplitude of the wave, which roughly determines the loudness of the sound, e.g., the higher the intensity the louder the sound.

Measuring noise in terms of its effects on people presents some problems. The first stems from the immense range of intensities to which the ear can respond; a normal scale would be unmanageably wide. Consequently, the range of numbers is expressed in units that represent the logarithim of the ratio between the given intensity and a standard that approximates the lowest intensity a normal ear can detect. The decibel (dB) is the common unit for expressing this ratio, and it should be noted that, like other logarithmic scales, it has some peculiar properties. For example, if we start with a noise level of 60 dB and then double the intensity of the sound, the noise level will rise to 63 dB, not to 120 dB.

Another problem in measuring noise is that how loud a noise sounds to a listener is not solely determined by the intensity of the noise. The human ear is less sensitive to low (50Hz) and high (15,000 Hz) frequencies than it is to medium frequencies (1,000 Hz), so a 15,000 Hz tone at a given intensity will not sound as loud to a person as a 1,000 Hz tone of the same intensity. To compensate for this problem, sound level meters have built-in circuits which make them less sensitive in the frequency range where the ear is less sensitive. The most common such equalization is the "A" weighting, and measurements made using this circuit are usually stated in dBA.

Another problem in the measurement of noise is that an increase in intensity does not produce an equal increase in loudness. Since dBA cannot be used to measure loudness directly, separate scales have been developed for loudness. For example in Steven's (1972) "sone" scale, a band of noise around 3,000 Hz is equal to 1 sone when the level is 32 dB. The perceived loudness of this sound is doubled (and thus comes to equal 2 sones), when the level is increased by 9 dB. Roughly speaking then, the loudness of a sound is doubled when the level is increased by 9 dB.

Measuring the noxiouness of noise directly would be very useful. Many people have constructed such scales (see Kryter, 1970; or Schultz, 1971, for a review), but studies comparing these various scales revealed that the dBA scale predicts how objectionable people find a noise as well as any other scale. Thus dBA is becoming the standard unit for measuring noise.

Measuring traffic noise presents special difficulties since the level of noise varies widely over time. The common solution to this problem is to specify the noise in terms of what level is exceeded a given percent of the time. Two such measures are the L_{10} and the L_{50}, and these refer to the level, typically in dBA , that is exceeded 10 percent of the time and 50 percent of the time respectively. Thus, for example, if the L_{10} is 72 dBA at some location along a street, that means that for 10 percent of the time the noise at that location was more intense than 72 dBA. L_{10} and L_{50} are the measures most often used to specify traffic noise guidelines.

Physiological Effects of Noise

The most serious physiological effect of noise is permanent hearing loss. (Burns, 1968; Corso, 1963, Kryter, 1970.) Exposure to excessive noise can cause damage to the structures of the inner ear, leading to what is termed nerve deafness (Davis, et al, 1935; Miller, Watson & Covell, 1964.) Over the past few years it has become increasingly clear that the role noise plays in producing deafness is much greater than was once assumed. Research has shown that a substantial measure of the hearing loss that accompanies age is probably due not to aging, but to the cumulative effect of a lifetime of exposure to noise (Corso, 1963; Rosen, 1962). For example, Rosen (1962) compared the hearing sensitivity of men in two age groups (10-19 and 70-79) in two different cultures, one relatively noisy (USA), one relatively quiet (the Mabaan people of Sudan). He found that although the older American men showed an enormous hearing loss when compared to their younger counterparts (up to 70 dB loss), age had much smaller effect on hearing in the Mabaan (less than 20 dB).

Data on noise-induced hearing loss are also available from studies on the effects of noise in the work environment (Botsford, 1969; Davis & Silverman, 1963; Robinson, 1971). For example, the National Institute for Occupational Safety and Health (NIOSH, 1972) has recently conducted a massive study on the relationship between the noise characteristics of working environments and

the hearing loss suffered by the workers. As is common in studies on industrial noise, evaluation of the hearing loss emphasized sensitivity to a narrow range of frequencies (1,000 Hz to 3,000 Hz) in the region where the ear is most sensitive, and where much of the information in speech occurs. Two criteria were used to evaluate the loss:

(a) it had to exceed 25 dBA, and
(b) it was compared to the hearing loss suffered by a similar group of subjects who worked in environments where the eight hour noise level did not exceed 80 dBA.

The NIOSH data show, among other things, that at retirement age (55-70) 35 percent of the population exposed to a steady 85 dBA level of work noise have an impairment of greater than 25 dBA for the mid-frequencies of 1,000 Hz to 3,000 Hz.

Since 20 percent of the people exposed to work noise levels below 80 dBA show impairment from other sources, it is concluded that the risk of suffering damage is 15 percent if the level of occupational noise is 85 dBA.

NIOSH recommended an occupational noise standard of 85 dBA for 8 hours exposure. It is important to remember that this standard allows at least 25 dB loss in the mid-frequencies, as well as virtually unlimited loss in the higher frequencies (above 3,000 Hz) and that it is designed to reduce the size of the hearing loss that occupational noise adds to the loss from other sources, such as recreational noise. Thus, if the level of a noise is below the NIOSH Standards, it does not mean the noise will produce no hearing loss; it merely means that the loss will either not exceed 25 dB in the range where the ear is most robust, or that it is not a great deal more than the loss suffered from other sources.

The noise levels necessary to produce hearing loss were once thought to be quite high, but more thorough research has demonstrated that prolonged exposure (8 hours/day) to even 80 dBA can produce a serious and cumulative loss (Kryter, 1970). It is not unreasonable to expect

that further research will reveal that still lower levels can produce a hearing loss, as data reported by Kryter (1970) already suggests.

Exposure to noise often produces a wide range of physiological changes, usually involving the cardio-vascular system including vaso-constriction, a rise in blood pressure, and other sympathio-tonic reactions (Jansen, 1969; Rosen, 1970). Part of these effects are components of the startle reaction that occurs when an unexpected loud noise is presented. It tends to diminish, therefore, with repeated exposure.

But there are also data showing continued physiological responses even when the subject is long accustomed to the noise. Jansen (1969); Rosen (1970), and others have demonstrated such prolonged effects with meaningless white noise of 90 dB. In addition, there is a growing list of studies showing similar physiological effects produced by noise of 70 dB, or so (Welch & Welch, 1970). In short, noise levels of 70 dB and above can result in physiological stress, and although this effect sometimes is reduced with continued exposure, other times no such reduction is seen.

In this context it is interesting to note that Rosen, et al, (1962; 1964), and others have found that among the Mabaans living in a traditionally quiet environment (35-40 dB) high blood pressure and coronary heart disease are unknown, but that the Mabaans who move to the noisy city of Khartoum develop both of these health problems. Also, a number of studies (Jansen, 1961; Shatalov, Saitanov and Glotova, 1962), have found a higher incidence of health problems, especially those related to heart and circulation, among people working in higher noise than those working in a somewhat less noisy environment.

As a group, these studies make clear that noise stresses the cardiovascular system, and they suggest that exposure to a noisy environment might contribute to coronary heart disease, though it is not possible to be certain as yet. Even [sic] the prevalence of heart disease in this country, however, especially among older citizens, the suggestion of a relationship should be sufficient cause for concern.

A common complaint concerning traffic noise is that it disturbs sleep (Bragdon, 1970; Galloway, et al, 1971; Schultz, 1971; Thiessen & Olson, 1968). Experimental research verifies that traffic noise can disturb sleep. Thiessen and Olson (1968) played a tape of a passing truck while subjects slept and determined the peak intensity necessary to awaken them. The experimentors found that five percent of the subjects awoke when the peak level was as low as 40 dB, and that 30 percent awoke when 70 dB was the peak level. More importantly, Thiessen and Olson (1968) found that the level of sleep shifted in many cases where the subjects did not awake, e.g., 60 percent showed a shift when the peak level was 70 dB. Since the amount of time spent at the various levels of sleep are critical to obtaining proper rest, people whose sleep level is altered by traffic noise are less likely to be rested, alert and relaxed.

Lang and Jansen (1967) have demonstrated that falling asleep takes a long time (1 1/2 hours) in the presence of a continuous noise of 50 dBA, and that subjects are fatigued when they awaken.

On the whole, the data make clear that noise levels in the 40 dB to 50 dB range can and do interfere with sleep, although there is considerable variability among subjects.

Psychological Effects of Noise

An important psychological effect of noise results from the fact that it can disrupt spoken communication. Noise can interrupt conversations in the home, disrupt the teaching environment of the classroom, and interfere with business transactions. It can also make it impossible to use the telephone or television. The degree of disruption caused by a noise depends on the intensity and frequency characteristics of the noise and is usually measured by an articulation index. Robinson suggests that a limit be set such that the L_{10} of a noise produce an articulation index no lower than 0.40. From Galloway et al, (1971), it can be seen that the L_{10} should not exceed 56 dBA when talkers are spaced 6 feet apart.

If talkers are 12 feet apart, as in a classroom, the L_{10} should not exceed 50 dBA.

Design Criteria

There are a variety of traffic noise guidelines available. The two most prominent are spelled out in:

(a) the Department of Transportation Policy and Procedure Memorandum (PPM) 90-2, and
(b) National Cooperative Highway Research Program Report (NCHRP) 117.

The first, PPM 90-2, is the most frequently cited standard. It specifies that design L_{10} should be 70 dBA outside and 50 dBA inside most structures, day or night. Rupert, who participated in the writing of 90-2, admits that a lower guideline L_{10} is warranted but it seems not to be within technical limits.

Galloway, et al, (1971), the authors of NCHRP 117, agree that an external L_{10} of 70 dBA is too high since they recommend an external L_{10} design criterion of 56 dBA during the day and 51 dBA at night.

Given that PPM 90-2 may be too high of a standard, we will consider the implications of the NCHRP 117 guideline as well.

Current Noise Levels

The current noise levels along East Mason Street were measured between March 12 and April 6, 1973. The reading sites were selected to provide a balanced sample of both mid-block and intersection locations, and interrupted (stop-light) and uninterrupted traffic flow from the west of the site. Three of the recording sites were situated directly in front of buildings (2 houses, 1 store). In these cases the site selected was always

the structure nearest to the street (as was recommended by the City Engineer's Office). The fourth site was located at the northwest entrance to Baird Place Park. The distances between the centerline of the street and the recording sites are given in Chart 1. All locations were situated on the south side of the street between Webster Street and the East River.

Readings were taken in 6 minute time-blocks with 72 readings per time-block. There were 10 of these time-blocks evenly spaced throughout each 2 hour recording interval and four 2 hour intervals were sampled (7 A.M. -9 A.M.; 11 A.M.-1 P.M.; 3 P.M.-5 P.M.; and 9 P.M.-11 P.M.), at each of the four sites.

Chart 1 presents the external L_{10} (dBA) noise levels obtained from the readings. As can be seen, the 70 dBA FHWA Standard was exceeded during both of the peak traffic periods (7-9; 3-5) at three of the four sites. The guideline was exceeded during all four intervals at the intersection of Irwin and East Mason Streets. The difference between the levels in Chart 1 and the design criteria recommended by Galloway, et al (1971) in NCHRP 117 (i.e. 56 dBA day and 51 dBA night) is large.

The extent to which the current noise levels on East Mason Street exceed the guidelines is more clearly seen in Charts 2-5. These figures plot the L_{10} noise level of each of the 6 minute time-blocks and thus illustrate the changes in level within the 2 hour sampling periods. The horizontal dashed line at 70 dBA represents the FHWA Standard (PPM 90-2) while the horizontal solid line at 56 dBA illustrates the NCHRP 117 guideline. The 70 dBA standard is frequently violated, sometimes by as much as 4 to 6 dBA. The design criterion from the NCHRP 117 is always violated, usually by a very large amount.

Interior noise readings were also taken at a number of sites. The data yielded by these sessions are presented in Chart 6. The current interior levels are all at or below the FHWA standard of 55 dBA. When the windows are opened for the summer, however, the levels at all locations will exceed both standards by as much as 10 dBA with respect to PPM 90-2.

Chart 1.

Exterior L_{10} Noise Levels in dBA For Each of Four Two-Hour Intervals at Each of Four Sites Along East Mason Street (PPM 90-2 Standard L_{10} = 70 dBA) (NCHRP 117 Guideline L_{10} = 56 dBA)

Site	Webster & Mason	1136 E. Mason	Irwin & Mason	1426 E. Mason
Nature	Entrance to Baird Place	Frame House	Accent Village (SW Corner)	Frame House
Distance From Centerline	Mason=38' Webster= 43'	40'	31'	45'
7 A.M.- 9 A.M.	71	70.1	73.4	68.8
11 A.M.- 1 P.M.	69.9	69.2	73.3	68.6
3 P.M.- 5 P.M.	72.6	71.4	73.2	68.9
9 P.M.- 11 P.M.	67.8	67.5	70.9	67

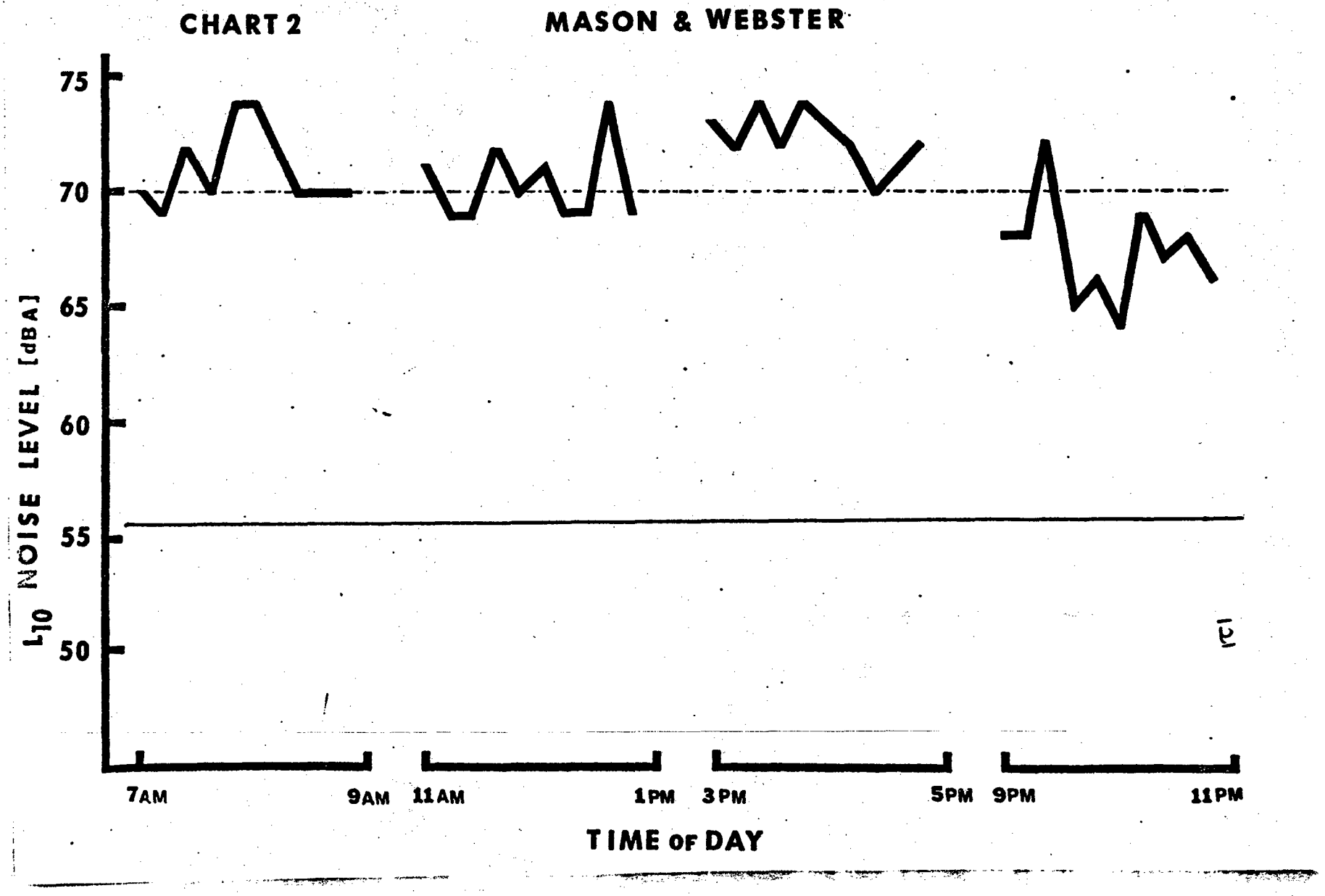
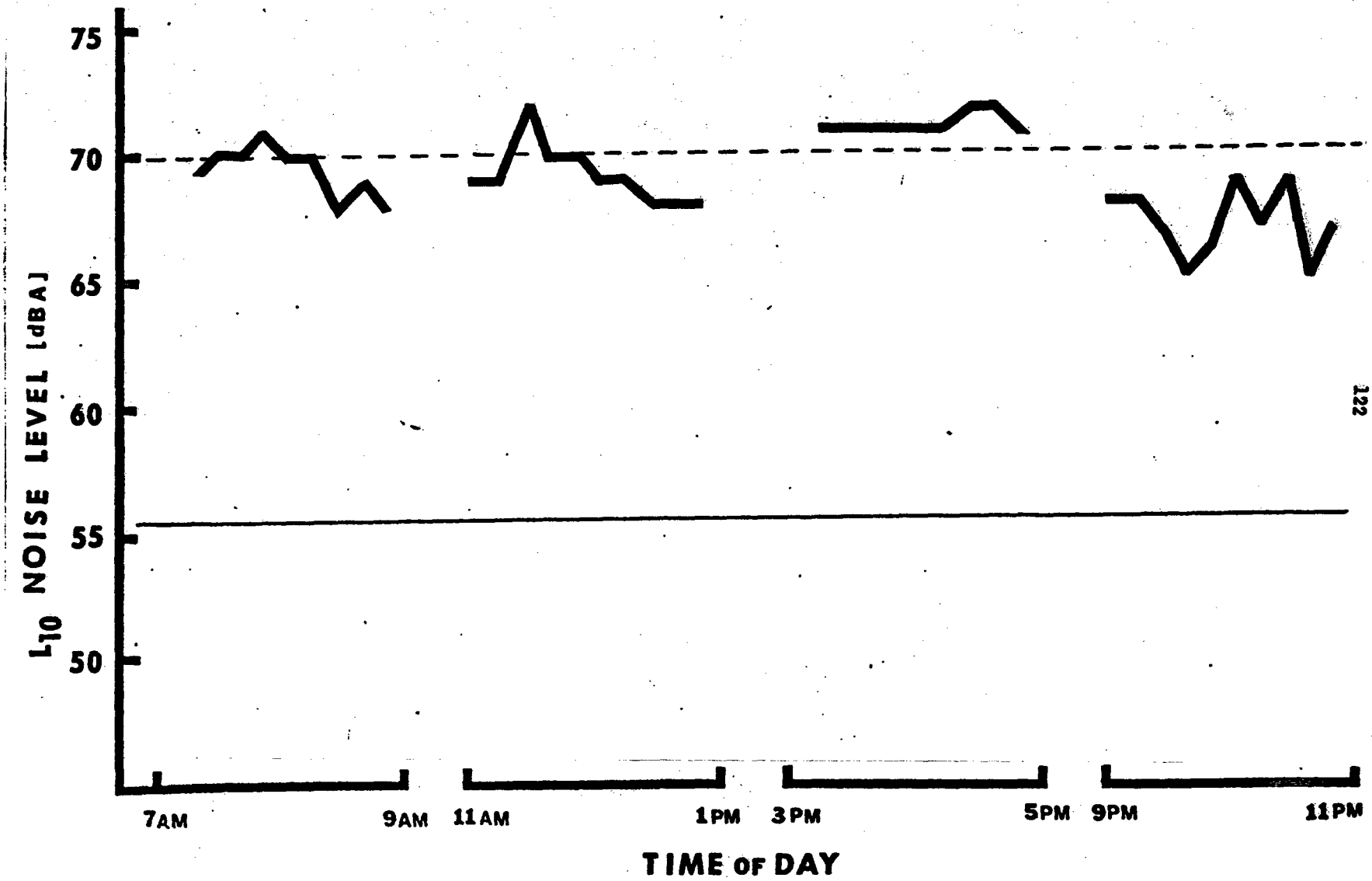


CHART 2
MASON & WEBSTER
75
70
65
60
55
50
L_{10} NOISE LEVEL [dBA]
7AM
9AM
11AM
1PM
3PM
5PM
9PM
11PM
TIME OF DAY

CHART 3 1136 E. MASON



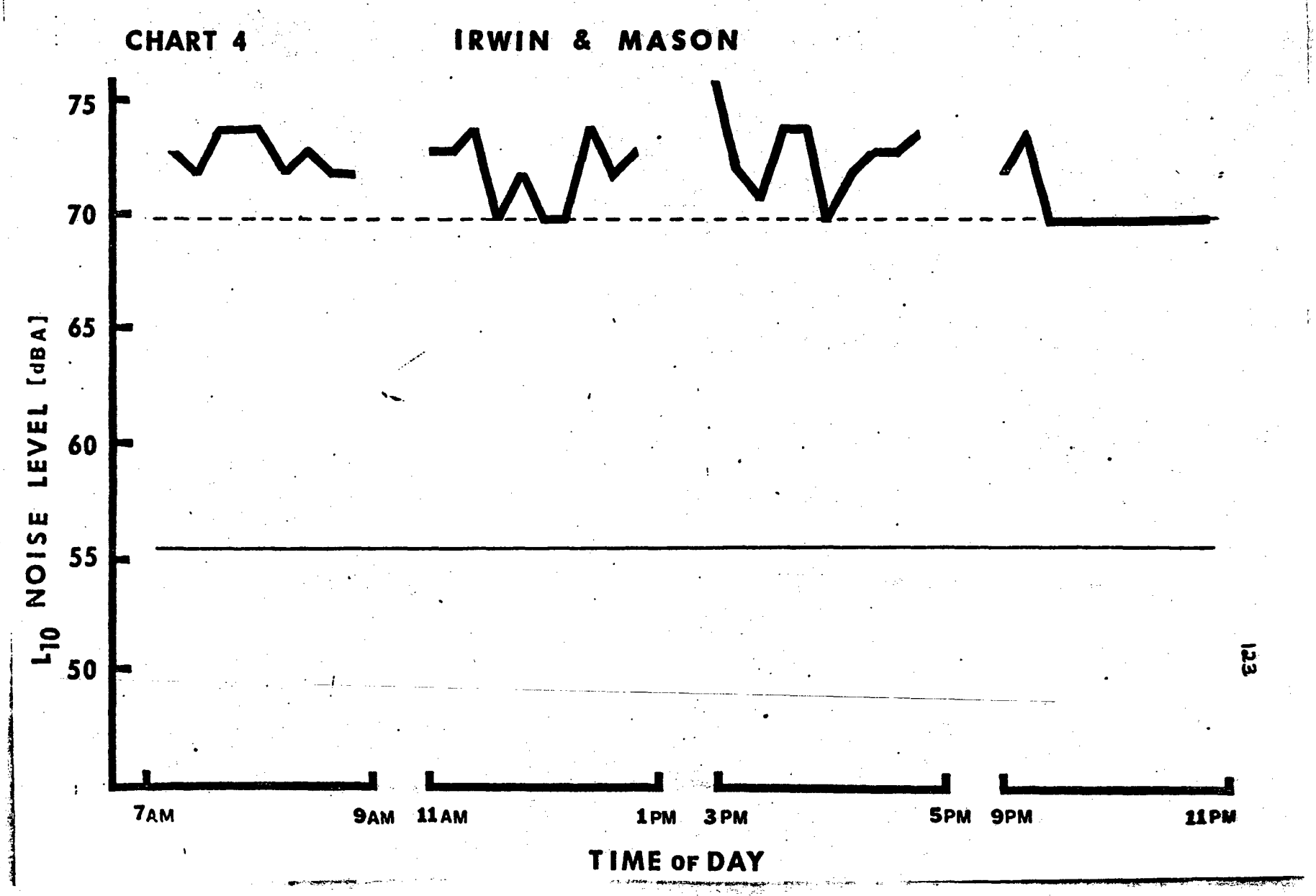


CHART 4
IRWIN & MASON
75
70
65
60
55
50
L_{10} NOISE LEVEL [dBA]
7AM
9AM
11AM
1PM
3PM
5PM
9PM
11PM
TIME OF DAY

CHART 5

1426 E. MASON

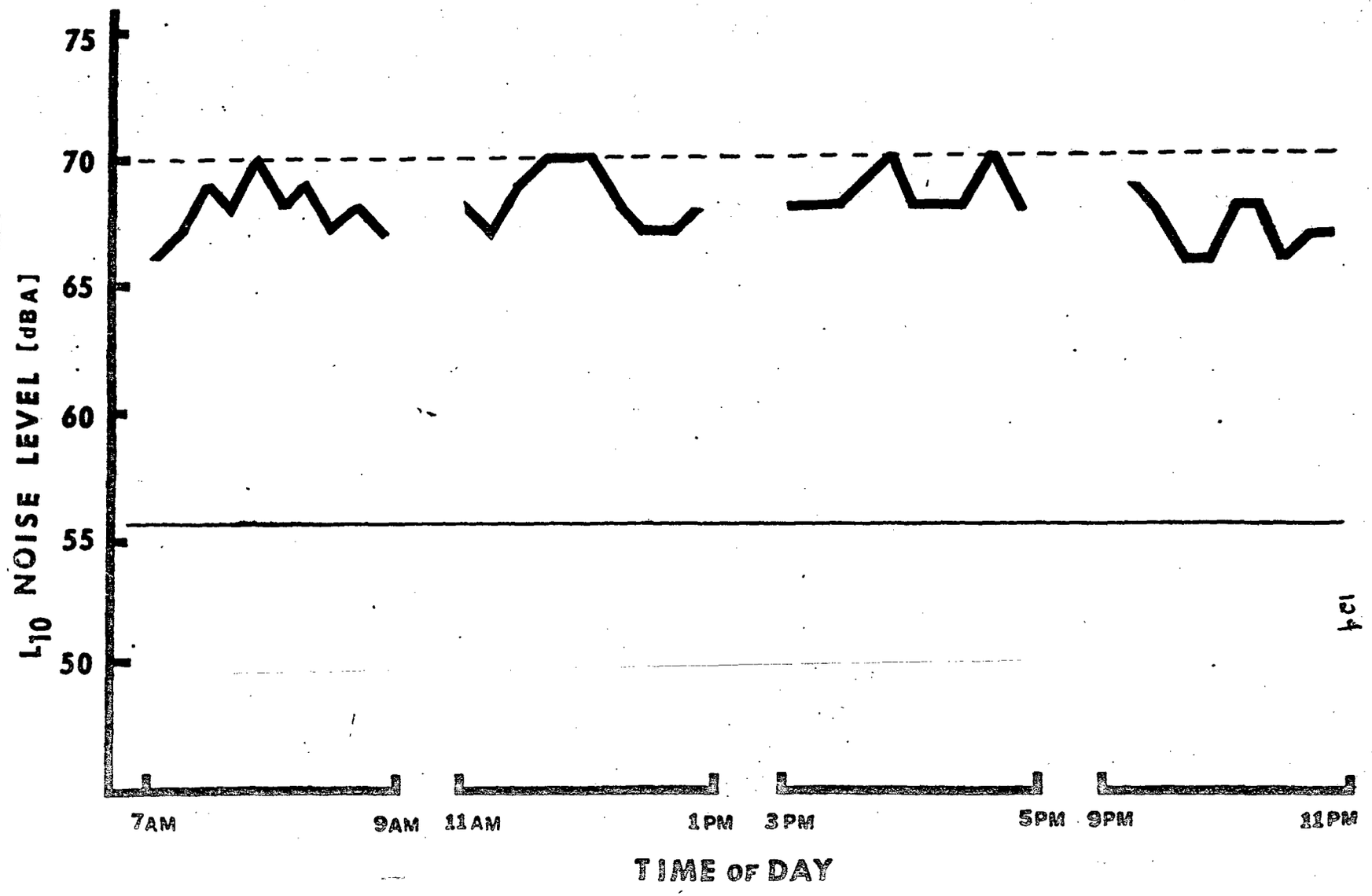


Chart 6.

Interior L_{10} Noise Levels Measured With the Windows Closed, and Estimated For the Windows Open, For the Time Period Between 3:15 P.M. - 4:45 P.M.
(PPM 90-2 Standard L_{10} = 55 dBA)
(NCHRP 117 Guideline L_{10} = 51 dBA)

Location	Distance To Centerline	Measured L10 Windows Closed	Predicted L10 Windows Open**
1136 E. Mason Street Frame House	40'	45.3*	60
1322 E. Mason Street Frame House	50'	46.3*	61
1422 E. Mason Street Frame House	50'	55	65
1426 E. Mason Street Frame House	45'	43*	58

* With Storm Windows in Place.

**Noise Increase Estimate From PPM 90-2.

Overall, then, the exterior L_{10} levels frequently violate the FHWA standard of 70 dBA, sometimes by as much as 4 to 6 dBA. Although the interior readings currently meet FHWA standard of 55 dBA, they will easily exceed that level when the storm windows are removed and the sash windows opened.

Interpretation of Noise Data

Interpretation of these levels must consider that the measured traffic volumes during the times the readings were taken were probably substantially below what can be expected when the bridge opens. For example, during the peak interval of 3 P.M.-5 P.M. hourly rates of between 650 to 950 were measured. If 8 percent of the ADT is used as the estimate of the peak period volume, and the standing projection is used as the estimate of the ADT after the bridge is opened, we can expect the rate to range from 1150 to 1300 vehicles per hour after the bridge opens.

NCHRP 117 can be used to estimate the increase in noise that would be produced by an increase in traffic volume and it suggests that the L_{10} between 3 P.M. and 5 P.M. would be elevated from 1 dB to 3 dB, depending on the site. For example this model predicts that the L_{10} at 1136 East Mason Street would probably be elevated to 74 dBA for the 3 P.M.-5 P.M. peak period. Similar, though smaller increases can be expected at other sites and times, inside and outside. In short, it can be expected that the traffic noise levels will even exceed the FHWA standard at virtually all the times and sites sampled, and substantially violate the NCHRP design guideline. For the citizens along East Mason Street, this means at least a disruption of normal living and a prolonged exposure to stressful interior noise levels that, when the windows are open, can approach 70 dBA. The data clearly show that, at a noise level of 67 dB, "shouting is necessary to carry on barely reliable conversation" (Beranek, 1950). Listening to television or radio will be very difficult since the HUD guidelines indicate that the interior noise level should not exceed 40 or 45 dBA if television and radio are to be comfortably understood. Research demonstrates that sleep can be

disrupted by noise levels this high, and physiological arousal occurs with exposure to such levels. The citizens in the project area are being subject to a barrage of traffic noise which has a level during the summer that can produce psychological and physiological stress.

Traffic noise is a serious problem to the people in the project area. Levin (elsewhere in this statement) found that 67 percent of the citizens he interviewed in the project area complained that they were disturbed by too much noise and vibration. All of the people spoken with during the taking of noise readings made a point of how much worse the noise is in the summer, when the windows are open, and that it is impossible to listen to the television in the front rooms of the house.

Clearly, the L_{10} traffic noise level along East Mason Street may well exceed a healthful limit, so it is imperative that serious efforts be undertaken to insure that the level not only be kept from rising, but that it be reduced to a less stressful level. Evaluation of the various proposals for reconstructing East Mason Street should stress the need for reducing traffic noise in the project area.

Reducing Traffic Noise Levels

Traffic noise levels can be reduced by a variety of ways including:

1. barrier walls between the roadway and the homes
2. earth berms between the roadway and the homes
3. depressing the roadway
4. landscaping the region between the roadway and the homes
5. sealing the windows, and air conditioning the homes
6. improving the street surface
7. reducing or eliminating truck traffic
8. reducing traffic volumes
9. increasing the distance between the roadway and the homes
10. reduce the noise level emitted by vehicles.

In this section the appropriateness and efficacy of each of these methods is discussed in preparation for the next section where the noise properties of the various proposals are evaluated.

1, 2 & 3 - Construction barriers, earth berms and a depressed roadway are clearly inappropriate. The barriers or berms would need to be 20 feet or more in height (Galloway, et al, 1971) thereby sealing off both the front of the house (visually), and the driveway. A depressed roadway would also preclude use of the driveways, as well as cause possible structural damage to the homes and disruption of utilities. All of these solutions would exhibit high cost, low effectiveness, and ugliness.

4 - Although landscaping the region between the roadway and the houses would be satisfying aesthetically, it would be of little value as a source of noise attenuation. Trees and shrubs reduce noise much less than is commonly assumed (Galloway, Clark & Kerrick, 1969). For example, to obtain a reduction of 5 dBA requires a 100 foot depth of trees at least 15 feet tall (Galloway et al, 1971). A shallow row of shrubs would have virtually no effect on the noise level, and certainly would not be sufficient to produce the 4-14 dBA reduction necessary here (Doc. 1970).

5 - It has been suggested that interior noise levels could be kept below the guidelines if the windows in the homes were sealed and air conditioning was used to cope with the heat of summer. At best, this is an impractical solution. Many of the residents in the project area are elderly and can ill afford air conditioning. In addition, operation of the air conditioners would add to the problem, since these units are often potent noise sources (Blazier, 1968; Bragdon, 1970). Most important, perhaps, air conditioners consume huge quantities of energy, and given the impending serious energy shortage, it seems irresponsible to mandate their use.

6 - Since a major source of automobile noise is produced by the interaction of tires and the roadway (EPA, 1971), improving the surface of the roadway reduces traffic noise. The difference between a rough asphalt surface

and a very smooth seal coated asphalt can be as much as 10 dBA. Reconstructing the street to improve the surface will reduce the traffic noise level, probably by 3 - 4 dBA if smooth asphalt is used on the surface.

7 - Trucks are much noisier than automobiles, on the whole (EPA, 1971). One truck can generate as much noise as 100 cars (Bragdon, 1970; EPA, 1971; UW-APL, 1971). The noise level depends upon the weight of the truck (UW-APL, 1971), with light duty delivery vehicles being the lesser offenders. Thus, lowering the volume of truck traffic, and restricting it to light duty units will eliminate some of the most potent sources of traffic noise along East Mason Street.

A decrease in the volume of heavy truck traffic could occur with the opening of the south beltway to the west side via the Allouez-Ashwaubenon Bridge. This reduction would be most likely to happen if the alternative parallel route to the west side (i.e., Mason Street) did not facilitate high flow truck travel. Widening and channelizing East Mason Street would enhance it as a truck route, however, and thereby encouraging rather than discouraging use by trucks.

8 - The same form of analysis applies to the volume of automobiles. Reducing the volume of automobile traffic will lower the level of traffic noise. For example, cutting the vehicle volume during peak periods from the projected levels of 1150 to 1300 vph to half that, would reduce the noise level by 4 dBA to 5 dBA, according to NCHRP 117 (Galloway, et al, 1971). But, when roadways are improved by widening etc., they draw traffic from parallel routes, as well as encourage additional travel (Frye, 1963; McElhiney, 1960; Ward, 1962; Voorhees, Barnes and Coleman, 1962). In short, widening the street will likely increase rather than decrease the traffic volume, and produce a consequent increase rather than a decrease in traffic noise.

9 - Sound operates according to the inverse square law, so increasing the distance between the roadway and the homes would reduce the noise level. Thus, for example, doubling the distance between a home and a low volume

street will lower the noise level at the home up to 5 dBA, depending on traffic volume and degree of reflection. If the roadway is moved farther from the homes, the noise level at the homes will be reduced. But if the roadway is moved closer to the homes, the level at the homes will increase.

10 - A most direct means to reduce traffic noise is to lower the level of noise emitted by vehicles. Though effective, this method would require legislation that would be difficult to realize.

This analysis indicates that the first five methods on the list are either impractical, expensive, or ineffective. The techniques numbered 6 through 9, however, would be effective and probably more feasible. Method 10, though effective, would be difficult to implement.

Evaluation of the Alternatives

Department of Public Works Proposal and the Rear Access Proposal -

Although some noise reduction would be effected with the reconstruction of the street surface, this advantage would easily be overcome by the increase in noise produced by moving the roadway closer to the homes and by the increase in traffic drawn by the improved facility. Moving the roadway 7 feet closer to the houses would produce an increase in traffic noise at the house of 2-3 dBA, even if traffic volume were unaltered. Thus, these two proposals have the most serious noise impact, since the noise level would exceed the standard through all intervals measured here.

Northside Acquisition Proposal, Southside Acquisition Proposal, and Reverse Curve Proposal -

Purchasing the homes on one side of the street and shifting the roadway in that direction would increase the distance between the remaining homes and the roadway and thereby reduce the level of traffic noise at the

homes by 2 dBA. Noise reduction would be effected in two ways with these alternatives:

(a) reconstructing the roadway surface, and
(b) increasing the separation between the noise source and the house.

However, since a widened facility would be built, an increase rather than a decrease in traffic volume could be expected, and thus traffic noise from this source will be increased. The noise impact of these alternatives, then, would be substantially less (5 dBA) than those of the DPW Proposal and the Rear Access Proposal, and thus allow the standard for exterior noise to be met during some of the periods, although the interior noise standard would still be exceeded when the windows are open during the summer.

Do Nothing Proposal -

Rebuilding the present street without altering its configuration should reduce the noise level by 3 dBA or more if a smooth asphalt surface is used. Maintaining the current configuration would avoid the problem of increased volume induced by a high capacity facility, and also would encourage cross-town traffic to use the impending east-west beltways. In this manner a 20 percent reduction in traffic volume might be realized with a consequent 2 dBA further decrease in the noise level. This alternative provides enough flexibility to directly determine if the traffic volume and noise on the street is reduced when these new east-west corridors are opened. That is, rebuilding the street with asphalt is relatively inexpensive. Thus, in the unlikely event that the noise level on the street remains elevated after the beltway is opened, and the configuration of the street must be altered to move it farther from the houses, the financial loss to the citizens is substantially less than if the roadway is widened and the change turns out to be unnecessary. However, this proposal could result in an increase in traffic volume on the streets that parallel East Mason, such as Cass, Chicago and Crooks. The noise impact of the Do Nothing Proposal should be substantially less (5 dBA) than that of the DPW Proposal and Rear Access Proposal, and, in the future, may be somewhat less than the Northside, Southside and Reverse Curve Proposals.

REFERENCES:

[Notations in brackets are either corrections or clarifications]

Beranek, L.L., Noise Control in Office and Factory Spaces, 15th Annual Mtg. Chem. Eng. Conf. Trans. Bull., 1950, 18, 26-33. [Transactions Bulletin 18, 1950, pp. 26-33, Industrial Hygiene Foundation of America]

Blazier, W.E., Jr., Criteria for Control of Community Noise, Sound and Vibration, May, 1968, Page 14.

Botsford, J.H., Simple Method for Identifying Acceptable Noise Exposures, J. Acous. Soc. Am., 1967, 42, p. 810.

Bragdon, C.R., Noise Pollution the Unquiet Crisis, Philadelphia: University of Pennsylvania Press, 1970.

Burns, W., Noise and Man: London: Muray, 1968.

Chalupnik, J.D., Transportation Noise: Symposium on Acceptability Criteria. Seattle: University of Washington Press, 1970.

Corso, J.F., Aging and Auditory Thresholds in Men and Women, Arch. Environ. Health, 1963, 6, 350-356.

Corso, J.F., The Experimental Psychology of Sensory Behavior. New York: Holt, Rinehart & Winston, 1967.

Davis, H.A., Derbyshire, A.J., Kemp, E.H., Lurie, M.H. & Upton, F., Functional Histological Changes in the Cochlea of the Guinea Pig, Resulting from Prolonged Acoustic Stimulation, J. Gen. Psychol., 1935, 12, 251-278.

Davis, H., and Silverman, S.R., Hearing and Deafness, New York: Holt, Rinehart, 1963.

Department of Commerce. The Noise Around Us. Report of the Panel on Noise Abatement. Sept., 1970. CTAB-71-1.

Dowling, R.J., Urban Ground Transportation Noise: An Overview. Transportation Planning and Technology. 1972, 1, pp. 27-38.

Department of Transportation. Transportation Noise and Its Control. June, 1972. DOT P5630.

Environmental Protection Agency. Transportation Noise and Noise From Equipment Powered by Internal Combustion Engines. December, 1971. NTID300.13.

Environmental Protection Agency. Fundamentals of Noise: Measurement, Rating Schemes, and Standards. December, 1971. NTID300.15.

Frye, F.F., The Effect of an Expressway on the Distribution of Traffic and Accidents. Chicago Area Transportation Study Publication, 66, 549, 1963.

Galloway, W.J., Clark, W.E., and Kerrick, J.S., Urban Highway Noise: Measurement, Simulation, and Mixed Reactions. NCHRP [National Cooperative Highway Research Program] Report 78, (1969).

Galloway, W.J., Gordon, C.G., Kuger, B.A., and Nelson, D.L., Highway Noise: A Design Guide for Engineers. NCHRP Report 117, 1971.

Jansen, G., Adverse Effects of Noise on Iron and Steel Workers, Stahl. Eisen., [Stahl und Eisen] 1961, 81, 217-220. [In German].

Jansen, G., Effects of Noise on Physiological State. Proceedings of the Conference on Noise as a Public Health Hazard, June 13-14, 1968, in Washington D.C., ASHA Reports 4 Washington: The American Speech and Hearing Association, 1969.

Kryter, K.D., The Effects of Noise on Man, New York: Academic Press, 1970.

Lang, J. & Jansen, G., Report on the Environmental Health Aspects of Noise Research and Control, United Nations, World Health Organization, 1967.

McElhiney, P.T., Evaluating Freeway Performance in Los Angeles, Traffic Quarterly, July, 1960, 296-313.

Miller, J.D., Watson, C.S., Covell, W.D., Deafening Effects of Noise on the Cat., Acto-Oto-laryngol., [Acta Oto-Laryngolica] 1964, Supplement 176.

National Institute for Occupational Safety and Health (NIOSH), Criteria for a Recommended Standard... Occupational Exposure to Noise. HEW, 1972, HSM 73-11001.

Robinson, D.W., An Outline Guide to Criteria for Limitation of Urban Noise. NPL Aero, Report Ac39, 1969, March.

Rosen, S., Bergman, R., Plestor, D., El-Mofty, A., & Satti, M., Presbycusis Study of a Relatively Noise-Free Population in the Sudan. Annals of Otology, Rhinology and Laryngology. 1962, II, 727-743.

Rosen, et al., Relation of Hearing Loss to Cardiovascular Disease. Trans., American Acad. Ophthalmology and Otolaryngology, 1964, 68, 433-444.

Rosen, S., Noise Hearing and Cardiovascular Function in Welch, BL & Welch; A.S. (Eds.) Physiological Effects of Noise, New York: Plenum Press, 1970, 57-66.

Schultz, T.J., HUD Noise Assessment Guidelines Technical Background. Office of Research and Technology, U.S. Department of Housing and Urban Affairs, 1971. HUD TE/NA 172.

Shatalon, N.N., Saitanov, A.O. & Glotova, K.V., On the State of the Cardiovascular System Under Conditions of Exposure to Continuous Noise. Defense Research Board, Toronto, Canada, 1962.

Thiessen, G.J., & Olson, N. Community Noise - Surface Transportation. Sound & Vibration, 1968, 2, 10-16.

Ward, D., Los Angeles; A Classic Example. Metropolitan Transportation, Jan., 1962, 15-17.

Stevens, S.S., Perceived Level of Noise by Mark VII and Decibels (E), J. Accouts. [Acoustical] Soc. Amer., 1972, 51, 575-601.

Welch, R.L. & Welch, A.S. (Eds.) Physiological Effects of Noise. New York: Plenum Press, 1970.

Voorhees, A.M., Barnes, C.F., & Coleman, F.E., Traffic Patterns and Land Use Alternatives. Paper presented at the 41st Annual Meeting of the Highway Research Board in Washington, D.C., January, 1962.

The passage cited below is a good example of the problems one can encounter in adequately assessing the impact of noise, particularly where the sponsoring agency has obviously not done its homework before putting pen to paper.

> The improvement will not lead to a noticeable change in the ambient noise level for a substantial number of people. It is recognized however that the closer proximity of adjacent property caused by the additional lane will increase traffic noise levels within these residences. This may be offset to some degree by the reduction in tire noise resulting from the higher type surface and smoother flow of traffic resulting from the additional lane.

It can be faulted from a number of angles. First, an assertion concerning the effects of a road improvement on ambient noise levels in the vicinity is made without reference to any supporting data. Perhaps, as the DEIS claims, it "will not lead to a noticeable change in the ambient noise level for a substantial number of people." But a reconnaissance of the area raises some questions, for not only will the improvement bring the road closer to the houses lining the route--a fact noted in the EIS-- but also it will require the removal of hedges and trees along the street which now serve as a partial sound barrier. This is not noted in the EIS. When these items are coupled with the marked increase in average daily traffic predicted by the highway department through 1993, and allowance is made for additional traffic which is normally generated by a new or improved facility, there seems to be sufficient possibility of a rise in ambient noise level to justify a noise evaluation survey to clarify the amount and extent of the impact. This was not done for the DEIS.

Second, while the DEIS recognizes "that the closer proximity of adjacent property caused by the additional lane will increase traffic noise levels within these residences," no attempt was made to determine whether these levels would exceed acceptable standards as designated by the Federal Government. Nor was any attention paid to the substantial body of literature on noise and its effects on human beings (see the bibliography included with the previous citation). The possibilities for disturbance of sleep, loss of hearing, etc., from exposure to traffic

noise deserve mention, as does the likelihood that noise sensitive individuals, or those who fear the effect of increased traffic on their children, might move, disrupting the continuity of the neighborhood.

Third, when a noise survey was finally conducted at the urging of the Environmental Protection Agency, whose reviewer faulted the DEIS for its omission, the sponsoring agency displayed the results in a way that makes them unintelligible. Instead of rewriting the section on noise impact, they chose to simply tack a sentence onto the paragraph in the draft.

> The improvement will not lead to a noticeable change in the ambient noise level for a substantial number of people. It is recognized however that the closer proximity of adjacent property caused by the additional lane will increase traffic noise levels within these residences. This may be offset to some degree by the reduction in tire noise resulting from the higher type surface and smoother flow of traffic resulting from the additional lane. Computer Survey shows existing L_{10} noise level of 68.2 dBA and an L_{10} noise level of 69.2 dBA for proposed conditions.

As the passage is written, one would have difficulty interpreting the significance of the noise levels cited even if he were familiar with the terminology used. For the benefit of the layman "L_{10}" and "dBA" should have been defined. Further, the methodology used should have been explained. Were these readings taken outside or inside? Where was the equipment placed in relation to the road? What type of sample was made to arrive at the figure cited? All of this information should have been supplied. A map or maps showing present and predicted noise contours starting from the midline of the road would have also been useful (an example of this type of map can be found on page 88).

Solid Waste Disposal

The disposal of solid waste from construction projects is a problem seldom treated is EIS. Yet, at a time when town dumps and sanitary landfills are coming under stricter operating regulations, and new sites for disposal of refuse are becoming increasingly difficult to find--nobody wants a dump located in his vicinity--the subject obviously merits dicussion. The State of Illinois Standard Specifications for Road and Bridge Construction (copies of which are frequently appended to Illinois highway EIS) call for the disposal of construction wastes within the right-of-way, either by burial or by burning. This is not always an acceptable solution, particularly in urban areas where Illinois Pollution Control Board regulations limit burning, and space limitations render on site burial impossible. Thus finding a site suitable for disposal and within reasonable hauling distance becomes a matter of some importance. Under these circumstances, especially, significant environmental impacts may occur.

The sole discussion of the impact of solid waste disposal we encountered is in the FEIS for the East Mason Street Project, Green Bay, Wisconsin. Of particular interest is the consideration given to possible salvage and recycling of materials. This is an avenue which should be checked since recycling to beneficial uses may frequently be the best means of disposal. Reuse of materials may also help lower the cost of the project. In addition, note the list of elements considered in analyzing the impact of solid waste disposal. The last three--land fill aesthetic impact, energy consumption for transport of waste, and transport nuisance factor--are easily overlooked in assessing the impact of solid waste disposal. This awareness of secondary impacts is seldom evident in EIS.

IMPACT OF SOLID WASTE AND ITS DISPOSAL

Solid Waste Generation and Disposal

Large volumes of solid waste would be generated by both the pavement removal and the building demolition necessary to the East Mason Street improvement proposals. Estimates of total solid waste volumes have been calculated based on the number and type of structures and on the pavement to be removed by each separate proposal (See Chart 1). Volumes range from

12,000 to 30,000 cubic yards. The variation is primarily due to the different number of residences included for demolition in the different proposals. The Department of Public Works (DPW) Proposal would result in approximately 12,500 cubic yards of primarily street debris. The remaining volumes were calculated with the assumption that all waste destined for land fill would be crushed with a bulldozer before being loaded on trucks.

Disposal of all solid wastes at the land fill site on Humboldt Road has been assumed, although much of the street debris (such as concrete) could be used elsewhere within the city. The possibility of salvaging lumber from buildings slated for removal was considered even though most wrecking firms presently think that such efforts are uneconomical. The reduction in solid waste that would result from lumber salvage has been estimated (See Chart 1). The lumber available for salvage has also been estimated (See Chart 2), with labor estimates for building demolition and lumber salvage included.

Environmental Impact of Solid Waste

The environmental impact of the solid waste that would be generated by each proposal has been analysed by considering the following impact elements:

1. Volume of waste (ten cubic yard truck loads)
2. Land fill spaces (acre feet)
3. Land fill transport and disposal cost (dollars)
4. Land fill aesthetic impact
5. Energy consumption for transport (BTUs)
6. Transport nuisance factor

Street debris, a component common to all the proposals, has been separated from other calculations. The impact of those proposals that call for a greater number of buildings to be removed (The Northside-Acquisition Proposal, Southside-Acquisition Proposal, and Reverse-Curve Proposal) would be greater than the impact of those that call for fewer buildings to be removed (The DPW Proposal and Rear-Access Proposal). Salvaged lumber significantly reduces the impact of the proposals calling for removal of a greater number of buildings, but not to a level comparable to the impact of the other proposals (See Chart 3).

CHART 1

Estimated Solid Waste Volumes With And Without Salvaged Lumber For Each Alternative

Solid Waste Source	No.	Alternative One		No.	Alternative Two A		No.	Alternative Two B		No.	Alternative Two C		No.	Alternative Three	
		No Salvage Cu.Yds.	Salvage Cu.Yds.		No Salvage Cu.Yds.	Salvage Cu.Yds.		No Salvage Cu.Yds.	Salvage Cu.Yds.		No Salvage Cu.Yds.	Salvage Cu.Yds.		No Salvage Cu.Yds.	Salvage Cu.Yds.
Street debris (common to all)		11000	11000		11000	11000		11000	11000		11000	11000		11000	11000
Sidewalk		1110	1110		660	660		660	660		660	660		1110	1110
Highway Business				4	1600	1520	3	1224	1140	3	1224	1140			
Church				1	215	40				1	215	40			
Business	1	260	220	9	2340	1980	16	4160	3520	16	4160	3520			
Residence	1	210	50	56	11760	2800	55	11550	2750	64	13440	320	11	2310	550
T.V.Station				1	2012	1800									
School				1	1700	1200									
Nursing Home							1	2115	900						
Totals		12580	12380		31287	21000		30709	19970		30699	16680		14420	12660

CHART 2

ASSUMING NO HOMES ARE MOVED

Estimates of Salvageable Lumber And Related Labor For Each Alternative

Alternatives	Salvaged Lumber		Labor *
	cubic yards	board feet	man months
1	35	11300	2
2A	1570	508000	100
2B	1630	525000	100
2C	1660	535000	110
3	240	77000	20

* Note: Based on Following Estimates

Building Type	Labor In Man Months
Residence	1 1/2
Business	1
Highway Business	1/4
Church	1
School	4
TV Station	2

Chart 3

Elements of Environmental Impact For Solid Waste Resulting From Each Alternative

Impact Element	Street Debris	Alternatives With Street Debris Not Included									
		Alternative One		Alternative Two A		Alternative Two B		Alternative Two C		Alternative Three	
		No Salvage	Salvage	No Salvage	Salvage	No Salvage	Salvage	No Salvage	Salvage	No Salvage	Salvage
1. Solid Waste No. of 19 cubic yard truckloads	1100	160	160	2030	1000	1960	900	1960	850	340	165
2. Land Fill Space In Acre Feet	6.8	1.0	0.7	12.5	6.2	12.2	5.5	12.1	5.3	2.2	1.0
3. Land Fill Transport and Disposal Cost[1]	$13,000	$1900	$1630	$24,100	$12,000	$23,400	$10,700	$23,400	$10,200	$4100	$2000
4. Land Fill Esthetic Impact[2]	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal	minimal
5. Energy Consumption For Transport in BTU[3]	231×10^6	24×10^6	21×10^6	60×10^6	45×10^6	56×10^6	43×10^6	54×10^6	41×10^6	27×10^6	24×10^6
6. Transport Nuisance Factor[4]	4	3.2	3.1	4.3	4	4.2	4.0	4.2	3.9	3.5	3.2

Notes: (1) Based Upon Following Cost Estimates -
Vehicle Cost (Capital Operating and Maintenance) = $5.00/truck load
Vehicle Operator Cost (3 trips per 8 hr. day) = $4.40/truck load
Land Disposal Site Cost = $2.50/truck load

(2) Existing Humboldt Road Site Assumed

(3) 2800 BTU/Ton Mile Assumed

(4) Logarithmic Type Relation Assumed for Total Number of Truck Loads

Nuisance Factor	Truck Loads
2	10
3	100
4	1000

Sociological Impact

This section attempts to illustrate methods of handling impacts for which no hard data are available; sociological impacts are a prime example. The first excerpt is from Ogden - The 12th Street Corridor which, although actually an appendix to an EIS, still serves well as an example. The procedure utilized includes a brief literature search, extensive personal interviews and group discusions with corridor residents, interviews with residents in other neighborhoods already impacted by similar projects, analysis of basic demographic data, and an evaluation of the alternatives.

The two sets of interviews bring out various sociological impacts which would be difficult to derive from hard data alone. Of particular note is the conclusion that a resident's preference among alternative road alignments is based almost solely on the level of impact on his individual family unit. This finding stands in marked contrast to the neighborhood cohesion so evident in other aspects of the corridor survey.

The citizens task force group which authored this report has attempted to represent community-wide interests in evaluating the alternatives. The method they use to examine and judge the data they have gathered is a slight modification of the standard weighting scheme used widely in social science research. For other approaches to relative valuation of alternatives, see Chapter II.

CHAPTER IV

TASK FORCE #3 - SOCIOLOGICAL IMPACT ON THE COMMUNITY

This task force was supervised by the Advance Planning Unit of the Transportation Planning Section, Utah State Department of Highways

Principals - Gary C. Ladle, Industrial Sociologist
Sue K. White, Sociologist
Donna M. McClure, Transportation Technician

In a pilot study, such as this is in the State of Utah, the procedures must necessarily reflect procedures used elsewhere when applicable. Before undertaking their assigned task, the principals researched the following documents to learn how the sociological aspects of transportation and highway construction could and should be considered.

Douglas C. Smith, Urban Highway Design Teams, Highway Users for Safety and Mobility, Washington, D.C.

Special Report 110, Relocation Social and Economic Aspects, Highway Research Board, Washington, D.C.

Systems Analysis of Urban Transportation, Volume 3, Network Flow Analysis and Volume 4, Supporting Analysis, General Research Corporation, Santa Barbara, California.

State of Michigan, Department of Highways, The Economic and Environmental Effects of One-Way Streets in Residential Areas, Lansing, Michigan.

Batelle Memorial Institute, Monographs on Potential R&D Projects, Columbus, Ohio.

It was felt by the principals, that, in transportation planning, there is an indication of insufficient understanding of the impact on the community traversed, caused by placement of a highway or other transportation facility. Some aspects of this type of impact are objective and measurement methods can be applied. However, many values are diverse and defy conventional measurement methods. Traditional consideration in highway location has given little attention to the sociological implications resulting from a particular project. Recently, however, such aspects have taken on sufficient value, nationwide, to be considered. Therefore, with the object of collecting data and evaluating attitudes of the respondents within the affected study area, two approach methods were used by the task force. First, the residents of the corridor were approached on a door to door basis. An effort was made to avoid the "census taker" image; rather, attention was directed to informal discussion of the proposals. Second, the task force established small discussion groups of 15-20 people in the homes of some of the residents to further explain the proposals and receive feedback. The proposals were illustrated through the construction of small scale models representing each of the proposals.

Neighborhood Unity

It was recognized by the task force that transportation change along the corridor would affect the neighborhoods and have disruptive influence upon their existing unity. Concern for this unity was held in mind as a result of a document published by the American Public Health Association, Hygiene and Housing, which stated that "The existence of a unified neighborhood is a strong force for the stability and development of individual family life. To retain its unity, a neighborhood should be physically self-contained in respect to most of the daily necessities of life. It will, in turn, obviously depend on the larger community for its basic employment, transporta-

tion and cultural facilities." Therefore, the sociological task force discussed noteworthy items with the people of the affected areas to determine the possible effects upon the neighborhood unity, etc. as caused by each alternate proposal. The respondents were asked to evaluate the effects of each proposal in terms of: cohesiveness, friendships, children's activities, church activities, recreation, noise, pollution, glare, traffic congestion, pedestrian hazards, quietness, and any other valued aspects they might suggest. The following text summarizes the attitudes of the respondents. It is recognized by the task force that many of the above stated variables are subjective and therefore no real measurement of effect can be obtained. Measurable elements are displayed in the charts and maps interspersed with the test. The discussion of each proposal is strictly from a sociological viewpoint. Factors such as economics and engineering are not generally considered or taken into account as aspects of the following evaluations.

ALTERNATE A - Widening 12th Street between Wall Avenue and Washington Boulevard.

It is proposed to continue widening 12th Street from Wall Avenue to Washington Boulevard, using the area between Washington and Adams to narrow 12th Street down to its present size and blend traffic into the existing street between Adams Ave. and Harrison Boulevard. Occasional response was obtained from the interviews indicating that Alternate A could be a temporary solution. There would be very little change in the eastern three quarters of the corridor from a sociological impact standpoint. The impact for that portion of the corridor between Wall Avenue and Washington Boulevard would be essentially the same as that for Alternate B, following.

ALTERNATE B - Widening 12th Street North Side

The intent of this proposal is to widen 12th Street from Wall Avenue to Harrison Boulevard.

To achieve a response toward this proposal, the task force contacted residents of 12th Street from Wall Avenue to east of 775 East and 13th Street for its length.

Contact was made, as mentioned above, by both door to door interviewing and small group meetings. In addition, a random sample was taken of shoppers at a nearby shopping center. The Board of Education was also represented by interviews with school principals in the area in question and also with the Superintendent of the School Board. The interview schedule sought to obtain from the respondents their feelings concerning the proposal from a standpoint of advantages and disadvantages for each alternate.

Those interviewed on a random basis in the store represented a cross section of the immediate surrounding area both within and

outside of the corridor boundaries. The majority of respondents indicated that the widening of 12th Street would provide the most advantageous solution to the traffic problem. However, an indication of apathy was demonstrated by many respondents because they felt the entire project had been forgotten. Long durations of unproductive activity appear to dim the interests of the people. The attitude of "just do something even if it is wrong" becomes very definite. Therefore, the mere passage of time has impact upon the people if they are left suspended and uncertain of their future. Owners indicated that they are unwilling to spend necessary money to provide adequate maintenance and repairs because they fear their homes may be removed. An attitude such as this results in a general deterioration of the neighborhood and many unforeseen ramifications may occur.

School Considerations

Located within the corridor are two schools, Mound Fort Jr. High and Gramercy Elementary School. Since each definitely will be affected by the second proposal, (Alternate B) the principals of the respective schools were questioned. The principal of Mound Fort indicated that five year plans would provide for moving the Jr. High to a new location with approximately 800 students enrolled. It was concluded that the second proposal (Alternate B) would not be advantageous for the school in its present location due to two factors: safety, and noise. The children presently are required to cross a very hazardous intersection and the second proposal would serve only to increase the hazards. Also, the present noise is disruptive to the children's concentration and increased traffic would only further complicate the existing situation. The sociological impact of the second proposal upon Gramercy Elementary School, as viewed by the school principal, was again primarily in terms of safety and the ramification which heavy traffic might have on the lives of young school children. It was indicated that the children attending the school were encouraged to walk if possible in order to eliminate traffic congestion and hazards around the school; any proposal which brings more traffic into the area would undercut the efforts to provide safety for the children and would have a profound affect upon the children and their activities.

The opinion of the Superintendent of Ogden schools was also sought. He felt that the widening of 12th Street would have the least impact upon the school activities in the long run, considering that Mound Fort at its present location will be discontinued.

Residential Attitudes

The task force then turned attention to a door-to-door survey to obtain the attitudes of the residents of both 12th Street and 13th Street. A very definite polarization of opinion was received. It is likely that this polarization of answers came

about because the residents have had a long time to think of the proposals and discuss possible consequences. The results of the interactions left those on 12th Street almost totally against the widening of 12th and those residents on 13th Street almost totally for the widening of 12th Street.

The following is a summary of the sociological implications obtained from the residents living on 12th Street and 13th Street, when asked for their views on the advantages and disadvantages of Alternate B. It should be stated that in many instances what would be an advantage for residents of one part of the corridor may well be a disadvantage for residents of another.

Advantages for Alternate B

1. It would create no new unnatural boundaries, which disrupt and change many existing interaction patterns and in turn result in the formulation of new patterns.
2. The quiet (cohesive), residential neighborhood of 13th Street would not be intruded upon and disrupted by increased traffic flow. Therefore, the sociological impact on 13th Street, resulting from additional noise, glare, pollution, congestion, traffic hazards, etc., would be avoided. It must be realized that such factors are significant and have influence on individuals' day to day living patterns; and, therefore, adjustment problems would face the 13th Street residents if traffic there were to be increased.
3. Present route habits of outside commuters using 12th Street would not be altered. This indeed can be listed as an advantage for the commuter; however, when conveniences are weighed, sociological emphasis must certainly be with the resident rather than the commuter.
4. Present route habits of local commuters using 12th Street would not be altered.

Disadvantages of Alternate B

1. Harmful after-effects would include the relocation of sixty-two households, a large percent of which are occupied by elderly individuals who have lived a major portion of their lives at their present location. Impact would be very heavy in terms of lost sentimental values, neighborhood cohesiveness and life-long friendships, which could not be replaced through mere relocation. Forced relocation is a highly disruptive and disturbing experience and a crisis with potential danger to mental health for many people. Reactions were expressed in terms of grief, continued longing and depression, sense of helplessness, and psychological or social distress. In addition, relocation necessitates adjusting and resocializing to a new environment which usually requires a pronounced change in life style. This has the greatest impact upon the elderly and among the working class. These are the types of people who would be affected and relocated by the widening of 12th Street.

2. The removal of one side of 12th for widening would create the potential of a slum development. Those residents left on the busy street would desire to move and with time a turnover of occupants would occur with a tendency toward a different type of development.

3. A definite increase in traffic would result in added congestion for remaining residents. This would increase the difficulty of mere access to and from the homes, thus making the home less desirable and incompatible with peaceful residential living.

4. The families, if any, left on the north side of 12th Street would lose 'most all feeling of unity with those residents on the south side. The turmoil and traffic movements in the street would result in partial isolation for the few remaining north-side residents.

5. Impact would be definitely felt by the children of the area. Increased traffic would increase hazards which would be felt both in daily play and also in getting to and from school. Concern for the children's safety becomes an important aspect in this proposal.

6. Well established shade trees would be destroyed. Beautification should be a primary consideration since this situation is one with which the residents must live and hopefully enjoy for many decades.

Summarizing

The second proposal (Alternate B) is advantageous because it protects the quiet established residential neighborhood of 13th Street. However, the proposal necessitates the relocation of 62 families and homes on 12th Street. From a sociological standpoint, this relocation has great impact because identities may be destroyed and a totally new life-style may be imposed. On the other hand, for residents remaining, life would be disrupted by increased traffic, speed, and noise. Such inconveniences one might at first think are easier to adjust to than total relocation. Reaction, however, of the respondents was almost unanimously in favor of being relocated as opposed to remaining in the situation caused by the increased traffic.

(Note: A similar discussion, not included here, is also provided for Alternate C, a one-way couplet utilizing 12th and 13th Streets.)

*** *** ***

ALTERNATE D - Mid-Block Expressway

Proposed by local architects and planners of Ogden City, this plan suggests that both 12th Street and 13th Street be left as they are, or preferably, reduced in width of asphalt. Instead, an expressway would be built through the vacant land and orchards on the inner blocks between 12th and 13th Streets. This proposal would cause no undesirable disturbance to the

front yards of either street, but instead, affect only the backyards of a few residents. The area of primary impact would be the four streets perpendicular to 12th and 13th: Porter, Jefferson, Liberty, and 775 East. The effect upon homes on these streets would be either: 1) the house would be removed; or, 2) the house would be left on a cul-de-sac but separated from the highway by a contoured greenbelt. Interview group meetings were conducted upon the four perpendicular streets and also upon 12th and 13th Streets to obtain feedback on the proposal. An interesting display of apathy and absence of polarization was demonstrated by the respondents when informed of the proposal and possible implications. This suggested to the task force that strong feelings were reached only if discussion time was possible among neighbors in order to develop positions as was demonstrated by the 12th and 13th Street residents on Alternates B and C. This assumption was verified later in the group meetings. Polarization had developed and apathy was no longer present.

Evaluation of the interviews taken on the perpendicular streets revealed that the home owners opposed the plan, as might be expected, because of the disruption and relocation problems. After a time lapse and further explanation, many residents on the perpendicular streets indicated a favorable attitude to Alternate D. However, it was strongly revealed that if the proposal were accepted, the home owners wanted to be relocated rather than being left so near the busy highway and somewhat isolated. Residents on 12th and 13th Street were also interviewed, with Alternate D receiving strong support. The following are the impacts of the proposal as anticipated by the respondents.

Advantages of Alternate D

1. Fewer homes than in Alternate B would be displaced and therefore, the severe impact of relocation would be lessened.
2. Twelfth Street would be relieved of a great part of its traffic permitting 12th Street to become a quiet residential neighborhood.
3. Thirteenth Street would not be affected and the neighborhood could retain its quiet, stable, cohesive nature.
4. The frustration and hazards of entering a busy street from a driveway would be eliminated.
5. Safety for children and pedestrians upon the residential streets would increase. Children's activities would not be hindered by excessive traffic.
6. Yards would not be partially taken in the front and thereby not deter incentive to maintain a beautiful and well-kept appearance. Instead, only some backyards would be slightly encroached upon.

Disadvantages of Alternate D

1. Relocation would be necessary for over 40 homes on the perpendicular streets. As on 12th Street, this would displace many long and well established residents. In addition, some new and very finely decorated homes would be displaced.
2. Those cross-street residents remaining may receive property damage but no compensation. For some, their home represents the total of their material possessions and therefore, the impact would be great.
3. Corridor environment could almost become that of solid asphalt among which a few remaining residents must live.
4. The highway would present a major divider of the religious congregation of the area. Impact would be the disruption of friendships and close ties that in many instances are lifelong. This division would be even more definite for children of the area who would be unable to cross the highway to visit friends on the other side.

Additional quantitative information of a sociological nature has been tabulated on the following 2 pages. It is followed by a general summary evaluation.

The following charts reflect patterns along the corridor, both for Twelfth Street and Thirteenth Street. Neighborhood bounds were arbitrarily selected as:

Wall Avenue to Washington Boulevard
Washington Boulevard to Jefferson Avenue
Jefferson Avenue to 775 East
775 East toward Harrison Boulevard

CHILDREN PER RESIDENCE (%)

Twelfth St.							Thirteenth St.					
0	1	2	3	4	5+		0	1	2	3	4	5+
67	26					Washington to Jefferson	85	5	5			5
60		20	20			Jefferson to 775 East	68		16	16		
61		11	11		6	775 E toward Harrison						

(The western end of Thirteenth Street has a very low ratio of children per household. Other areas in the corridor have a low ratio of children per household but not as low as the western end.)

NUMBER OF AUTOMOBILE OPERATORS PER RESIDENCE (%)

Twelfth St. 0	1	2	3	4	5+		Thirteenth St. 0	1	2	3	4	5+
						Wall to Washington	25	25	50			
6	43	39	6		6	Washington to Jefferson	16	39	30		15	
	33	13	54			Jefferson to 775 East	20	20	20		40	
15	25	30	15			775 E toward Harrison						

(As may well be expected, the percentage of licensed drivers throughout the corridor is high. This does not, though, reflect the number of available automobiles.)

EDUCATIONAL LEVEL OF ADULT RESIDENTS (%)

	Below HS	HS	Col-lege	Post Grad			Below HS	HS	Col-lege	Post Grad
					Wall to Washington	Male		66	34	
						Female		50	50	
Male	25	31	31	13	Washington to Jefferson		20	40	30	10
Female	21	51	21	7				71	29	
Male	7	71	21		Jefferson to 775 East			50	25	25
Female	16	58	26					40	60	
Male	13	39	48		775 E toward Harrison					
Female	20	66	14							

(With the exception that the general education level is fairly high, no other significant pattern is evident.)

INCOME LEVEL OF RESIDENTS (%)

	under 5,000	5 to 8,000	8 to 10,000	over 10,000	SS, Ret. Pension
Twelfth St					
Wash. to Jefferson		23		23	54
Jefferson to 775 E	9	9	18	18	46
775 E toward Harrison		10	5	20	65
Thirteenth St					
Wall to Washington		25	25		50
Wash. to Jefferson	7	14		7	72
Jefferson to 775 E				50	50

(The high percentage of elderly persons shown on the map of average ages is reflected here in the number of families living on Social Security and retirement pensions. The general income level also rises slightly as one moves east through the corridor.)

COMMUTING HABITS OF RESIDENTS (%)

	To Work				To School			
	Drive	Walk	Car Pool	Bus	Drive	Walk	Car Pool	Bus
Twelfth St								
Wash. to Jefferson	93	7			60	40		
Jefferson to 775 E	100				25	75		
775 E toward Harrison	100					100		
Thirteenth St								
Wall to Washington	100					100		
Wash. to Jefferson	100					50	50	
Jefferson to 775 E	100					50	50	

PERSONAL TRANSPORTATION (%)

	To Church			To Club-type Activ.		
	Drive	Walk	Don't go	Drive	Walk	Don't go
Twelfth St						
Wash. to Jefferson	73	22	5	33		67
Jefferson to 775 E	62	23	15	27		73
775 E toward Harrison	51	35	14	16		84
Thirteenth St						
Wall to Washington	84	16		33		67
Wash. to Jefferson	75	13	12	37		63
Jefferson to 775 E	83	17		60		40

Inasmuch as neighborhood sizes are not the same and the tabulations were made from a sampling of each, the above tables should only be used as a cursory guide and not be used to establish statistically valid relationships. In general, the above figures do show a fairly homogeneous character throughout the length of the corridor.

Summary

From the Sociological Impact Study conducted, the task force has observed the dramatic impact that is resultant of change. Each of the respondents acknowledged that change is vital and necessary in the growing and maturing City of Ogden; however, each desired change at a minimal personal cost. As stated in the text, and shown on the map, a very definite polarization of opinion was observed among residents of 12th and 13th Streets in the door to door survey (however some vacillation from this appeared in the group meetings). Those of 12th almost unanimously favored the one-way couplet because of the advantages to themselves. Namely:

Decreased traffic and congestion.
A more residential atmosphere.

Very little concern was given to the disadvantages involved in the proposal:

Elimination of quiet, stable atmosphere of 13th Street.
Destruction of natural beauties.
Disruption of two neighborhoods, rather than keeping traffic in one place.
Disruption of church boundaries.
Deterioration of yards.

On the other hand, residents of 13th Street were almost totally for the widening of 12th Street because if Alternate B is accepted, no real impact would be felt by 13th Street residents and the neighborhood would remain as is. However, little concern was given for the disadvantages such as:

Displacement and relocation of 62 homes.
Possible slum development.
Increased traffic on 12th Street.
The hardship of elderly citizens being relocated.

Introduction of the fourth alternative seemed to continue the same trend of personal concern rather than community. Residents on 12th Street and 13th Street tended to favor the proposal because minimal disruption would be caused to them personally.

Little concern was given for the disadvantages such as:

The formation of a definite barrier and divider.
Displacement of over 40 homes.
Development of an asphalt jungle.
Property damage.

On the other hand some occupants on the perpendicular streets favored either Alternate B or C because it would bypass them without serious impact. Therefore, the conclusion can be drawn that personal interests are extremely important and were of primary importance to the people as they evaluated the sociological implications of the proposals. Therefore, the conclusions drawn by the people are very subjective in nature and community interest is not of prime concern.

In addition to the people's opinions, the school board is dominantly in the picture. The first preference of the school board is to widen 12th Street. This conclusion was drawn due to concern for students' safety. With the widening of 12th Street, 51% of the students would not have to cross a highway. Also plans indicate that the Mound Fort Jr. High will be discontinued on 12th Street and therefore would not be on the widened busy street.

Another factor of concern is the political climate created by the political leaders who live or own property within the cor-

ridor. Their views have been very important in formulating opinions from the couplets to the widening of 12th Street.

Findings of the Sociological Task Force indicate: that the residents involved very much enjoy their neighborhoods; that the age level of the families varies from very young to extremely elderly individuals who have lived at their present residences for many, many years; that neighborhood cohesiveness and identification is very strong with numerous lifelong friendships existing. In addition, the neighborhoods are relatively quiet and uncongested except for 12th Street, where traffic congestion is presently a problem for the residents. For the most part then, the corridor is a somewhat typical residential section but with still a flavor of a rural atmosphere.

Finally, in obtaining the opinions of the people, it was observed that the polarization was due to personal concern of each for his own future. Community good and progress were almost exclusively secondary in nature in formation of opinions. Independent variables which were hypothesized to affect opinion formulation (income, number of children, number of drivers in home, church activity and club activity) failed to be significant.

However, educational level did show positive significance. Those with greater education also demonstrated increased awareness and concern for community development. Concern for personal convenience and relationships seemed to override all other variables.

Salt Lake Area Comparisons

In order to more adequately recognize and evaluate the sociological impact of highway placement and construction, the sociological task force conducted a related study of two neighborhoods which in the past 5 years experienced a similar situation as that of 12th and 13th Streets in Ogden. The first neighborhood study was along 13th East in the vicinity of 24th to 27th South in Salt Lake City. This neighborhood was chosen because extensive widening (similar to Alternate B) had taken place which resulted in the displacement of many homes and relocation of families. The second neighborhood was that of Stratton Drive just south of 4500 South which had had one side removed by the construction of I-215. The interview schedule sought to obtain the impact of the construction upon the people from its beginning to end. Topics upon which information was sought were: 1) feelings toward neighborhood, 2) cohesiveness, 3) impact of the new construction, and 4) problems during construction.

Respondents interviewed for the study were only those who were left and not those who had been relocated to other neighborhoods. Responses obtained concerning the impact of the construction were rather varied. Most respondents. however, mentioned that they still enjoyed their neighborhood but the loss

of neighbors and friends had somewhat disrupted past social groups. However, those still resident felt some of the cohe siveness remaining.

Most of the impact appeared to come from the actual construction, however, rather than from neighbor losses.

It was indicated by the respondents that the Highway Department appeared to fail them in demonstrating sufficient concern during construction and the following periods. Dirt, traffic congestion, and seemingly unsafe conditions severely hampered the residents. Respondents felt that much could have been avoided with merely more concern. Some indicated damage to both homes and yards that was not compensated for by the Department; thus, distrust and resentment had arisen. Many respondents also expressed a lack of desire to improve their homes because of uncertainty as to the future of the situation.

From a sociological point of view, the impact on the people of the neighborhoods was as follows:

1. Lack of neighbors and friends
2. A feeling of being somewhat abandoned and isolated
3. Pollution problems, such as dirt, increased
4. Poor safety conditions due to make-shift devices
5. No compensation for some damages. Therefore loss must be absorbed personally
6. Uncertainty resulting in a lack of desire and in turn a degeneration of the property
7. Distrust and resentment resulting from allegedly unkept promises

Efforts should be made by the Highway Department to incorporate into the plans a program that keeps the people and their best interests in mind during and after construction. The impact of friendship loss is difficult but could be softened for the people if efforts were exerted to minimize the other impact cases. By so doing, some residents would not be forced to pay unfair costs for progress.

GCL

Comparative Rating

Subjective evaluations can be rated on a scale in much the same manner as quantitative evaluations. The only variable that is difficult to pin down is the human one. Inasmuch as sociology is primarily a humanistic science, the human element is still the most reliable determiner to make a rating scale. In order to reduce personal preferences, prejudices and bias of the principals, eleven different factors have been considered, rated separately and then cumulated, weighting each factor as shown in parenthesis.

SOCIOLOGICAL RATING:

Factor	+10 +9 +8 +7 +6 +5 +4 +3 +2 +1	0	-1 -2 -3 -4 -5 -6 -7 -8 -9 -10
Commuting Convenience (3)		B A	C D
Relocation (5)		C	A D B
Psychological Stress (2)		D	A B C
Social Stress (2)		D	A B C
Impact by Vehicles (2)	D	A B	C
Impact by Pollution (3)		D B C	A
Boundaries (1)		A B	C D
Children's Activities (2)	D		A B C
Cohesiveness (2)		D	A B C
Aesthetics (3)			A B D C
Potential for Community Development (5)	D	B A	C
Cumulated weighting -		D A	C B
		+1.0 -0.3	-1.0 -1.1

From this weighting and rating it would appear that Alternate D can be considered to be of greatest benefit to the community sociologically.

DMM & GCL

The second example, taken from the DEIS for F.A. Route 171 (Illinois Route 76), Belvidere Bypass, Boone County, Illinois, describes the financial compensation and relocation assistance programs available to persons who are displaced from their homes or businesses by highway construction. This kind of detailed information is necessary if the reviewer is to adequately evaluate the real impact of relocation on people. Moreover, making the facts about assistance programs and compensation known to those affected as soon as possible, and in as much detail as possible, can help alleviate considerable tension and ill will resulting from condemnation proceedings.

E. Displacement of People:

In Item III, A of this statement it is stated that one home and possibly one tavern will be displaced by this highway project. The Illinois Division of Highways Relocation Assistance and Payment Program will be made available with consideration to the individual needs of the affected individuals.

At the time negotiations for acquisition of right-of-way are started, the owner of a parcel sought for highway purposes will be advised of this program.

The relocation assistance is offered to all individuals, farms and businesses displaced by this highway improvement. This assistance is available to both tenants and owners.

A personal contact is made by Relocation Assistance personnel to determine from the affected property owner whether he desires assistance.

The assistance offered consists of a residential, farm or business moving allotment, and aid in obtaining suitable and comparable living and business locations.

Relocation advisory assistance personnel will have listings of available homes, apartments, farms and businesses to aid those people who are displaced to obtain new living or business locations.

In addition, they will be at the property owner's disposal to aid in the selection of alternate locations and to assist in completing forms necessary for receiving the moving and supplemental payments.

The Federal Highway Act of 1968 provides new and more liberal compensation for families displaced by highway construction. All displaced persons will be compensated for moving expenses. Owner-occupants of single, two or three family dwellings whose homes are acquired can receive payment of up to $5,000.00 more, if needed, to purchase a comparable property and will be advised of the amount of the supplemental payment at the commencement of the negotiations.

An amendment to the Illinois Highway Code, approved September 17, 1971, allows a payment of up to $15,000 for this purpose. Families who rent can receive a rent supplement of up to $4,000.00 when a dwelling unit comparable to the one displaced has a higher rental.

A family could choose to apply the entire amount up to a maximum of $4,000.00 as a down payment in purchasing of a new home.

D. THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG TERM PRODUCTIVITY

One of the most difficult tasks faced by the writer of an EIS is determining "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." NEPA itself offers no guidelines, and a review of a variety of EIS makes it clear that most writers are uncertain just what is called for. This matter can perhaps best be clarified by use of an example.

A common instance of the conflict between local short term uses and long term productivity is the filling of marsh land. In the short run the reclaimed land may be valuable for housing or recreation facilities, but in the long run the elimination of these crucial breeding grounds for aquatic life may drastically reduce the numbers of certain species, with an attendant impact on future food resources. Thus the immediate benefits from construction of highways over marshland, or flooding or draining wetlands for recreation, etc., must be balanced with long range needs.

With this general framework in mind one can now venture some tentative definitions of short term and long term. Short term refers to the immediate effects of a project while the long term is the period over which direct or indirect effects of the project are apparent. The long term thus includes at a minimum the construction, operation, and eventual disposal or disappearance of the project. For some projects which alter the course of other events, the long term is effectively infinite. The effects of dam building on surrounding land use and natural systems will live on even after the reservoir has filled with sediment. Hence the decision to construct a dam now establishes a chain of events which future generations must be content with.

The discussion quoted below, from the Tijuana River Flood Control Project DEIS, is an example of an excellent comparison of long and short range effects. Note particularly the point made that protection of the valley floor will lead to land use changes which may or may not be desirable. The loss of estuary area is identified because the project may tend to encourage its destruction, even though it does not directly

cause this destruction. This thorough development of long term interaction is laudable.

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Implementation of the flood control measures may result in a further reduction in the ground water supply and the quality of the soil and ground water in the Tijuana River valley. Two other indirect long-term effects may result from implementation of the recommended plan:

1. Loss of fertile agricultural lands and open-space areas--one half or more of the valley floor--to residential and commercial developments;
2. Loss of all or part of the estuary, including wetlands, wildlife habitats, and a number of endangered species as a result of the construction of an inland bay and marina in the estuary, in accordance with the City of San Diego General Plan.

The loss of the estuary is somewhat less probable than the loss of open-space lands further inland. Neither of these indirect effects are an absolute result of channel construction.

At present cultivation of the area is viewed only as a short-term effort. It is apparent that agriculture in the valley is in a very poor state. The high quality of the soils, however, has been established in the past. If the salt could be flushed from the surface layers and if the ground waters were recharged, then agricultural activities might flourish again in the valley. Because of the rich soil, some farmers have begun to import irrigation water from outside the valley. The expansion of such imports should assist in the recharge of the ground water supply and the flushing of soil salts and, possibly, the renewal of agricultural activities on abandoned farmlands.

The need for open space and agricultural areas will increase with our rapidly expanding population. In recent years, however, there has been a substantial decrease in the area of land under cultivation in this region. From 1950 to 1966 the crop acreage in San Diego County decreased from 114,000 to 51,000 acres. During the same period cultivation areas in the City of San Diego decreased 70%, from 70,000 acres to 21,000 acres (22). The reduction resulted from the infringement of metropolitan growth on the agricultural lands. The agricultural industry was the fourth largest in the county in 1969, when total agricultural production had an estimated value of $146 million (23).

The continued use of rapidly diminishing agricultural lands for farming purposes is economically beneficial to the region. The use of high-class agricultural lands for non-agricultural purposes is wasteful of our limited natural resources. Commercial and residential areas can be established elsewhere on more plentiful lands not well suited for cultivation.

The retention of agricultural lands around the city will help retard "urban sprawl" and aid in the development of a more compact city. This retention also will assist in the provision of open space needs required by the urban population of San Diego. The continued growing of vegetables and other food crops within the valley will reduce transportation costs and other transport problems associated with the importation of the city's food supply. The continued existence of an agricultural industry in the city will permit local residents to have the opportunity of purchasing field-fresh produce at competitive prices. The implementation of flood control measures within the valley would result in the loss of 1100 to 2500 acres of farmland.

Article 2 of the California Land Conservation Act points out that:

1. The preservation of a maximum amount of the limited supply of prime agricultural land is necessary to the conservation of the state's economic resources and is necessary to the maintenance of the agricultural economy of the state;
2. The discouragement of premature and unnecessary conversion of prime agricultural land to urban uses is a matter of public interest and will be of benefit to urban dwellers themselves;
3. In a rapidly urbanizing society agricultural lands have a definite public value as open space, and the preservation in agricultural production of such lands constitutes an important physical, social, aesthetic, and economic asset.

According to the City of San Diego (22):

> Agriculture could help importantly in securing another principal objective of the General Plan: namely, "Reservation of Open Space Systems." The leasing back of various public open-space lands for agricultural purposes could underwrite much, if not all, of the maintenance costs likely to be associated with the projected Metropolitan Open Space System.

It is concluded here that the protection of the valley floor from floods probably could result in the loss of valuable agricultural lands to future generations, regardless of how

the valley is developed. If the farmlands are utilized for residential and commercial developments, then their loss to succeeding generations is certain.

The loss of the estuary is not a direct consequence of the construction of the channel. Such a loss can be prevented by designating the area a wildlife refuge. However, there are substantial benefits to be derived from conversion of the estuary into commercial, recreational, and residential areas, and there are strong forces intent on carrying out such a plan, which requires flood protection. Therefore, a brief discussion of estuarine values appears warranted.

Estuaries on the west coast are of two types: (1) those with predominantly salt water marshes and (2) those with predominantly fresh water marshes. Each forms a habitat for two distinct assemblages of organisms; some organisms, of course, can thrive in both of these environments. Along the west coast the salt water marshes were generally found around the margins of the larger bays, while the fresh water marshes were found in the very small bays which lacked continuous circulation with the sea. All of the larger bays have been utilized for harbors and marinas. As a result, most of the salt water marshes within the state have been destroyed or highly modified by dredging or suffer from extensive pollution generated by maritime activities. Consequently, there are very few high-quality salt marshes remaining within the state.

The Tijuana estuary salt marsh is unquestionably the finest in Southern California, and perhaps in the entire state. This rating is based on the purity of the waters and the great variety of plants, fish, invertebrates, and birds found in the estuarine waters and surrounding wetlands. It is also a haven for the four designated endangered species. These species have few remaining habitats left, aside from those found in the Tijuana estuary which are suitable for their existence.

Many conservationists believe that almost all estuarine organisms are endangered species. Because of extensive pollution, dredging, and marine construction and other modifications in California estuaries, most truly estuarine organisms are in danger of extinction. These organisms depend totally or partially on estuarine marshes for their continued existence. For this reason, it is important that remaining areas, such as the Tijuana estuary, be maintained as nearly as possible in their natural state. The validity of saving a few assorted weeds and animals may be seriously questioned by those who have not studied the environment. They fail to realize that millions of years have been required for the development of each individual species. To those unfamiliar with nature it may seem unlikely that the existence of so many different organisms has any value to man. However, experience suggests that the truth may be quite the contrary.

> A discussion of the salt marsh plants may illustrate an unsuspected use for these "nuisance weeds" which, like all organisms, have a direct ecological importance. It has recently been realized that some of these salt-tolerant plants may indirectly provide the key to solving the increasing problem of salt build-up in the soils of semi-arid farmland regions of the world. The natural salt resistance of the salt marsh plants may be utilized in the near future to introduce genetic salt tolerance into commerically-important plants through cross-breeding. Research in this direction has only recently been started in San Diego. The success of this program is obviously heavily dependent on the preservation of wild stocks of salt marsh plants from which to draw desirable genetic lines. The fact that many of the salt marsh plants in the California coastal wetlands are not found elsewhere in the United States and that already over 60% of this plant habitat has been destroyed in California makes the preservation of remaining marshlands an urgent consideration.

When considering local short-term use versus the maintenance of long-term productivity, it is essential to make clear the implicit tradeoff between them, i.e., in opting for immediate gain one may be foreclosing options for gain at some future time. Highway construction is, for example, generally followed by marked change in land use patterns. Where this process results in homes being built on farmland, there is an immediate gain in available housing units. At the same time, however, the amount of land available for cropping has been decreased, or, to put it another way, the opportunity to use the land for farming purposes at any time in the future has been effectively foreclosed. In the citation which follows, however, the writer failed to see this short-term versus long-term relationship, even to the extent of denying such a relationship. His analysis is, as a result, of questionable validity.

The writer also failed to consider what effect the construction of the highway might have on any future plans for inaugurating mass transit in the area. If the result of building the highway is to further our commitment to an inefficient means of transportation, and to foreclose or put off the initiation of such alternative transport means as bus service, then this is a short-term versus long-term tradeoff which requires mention.

The final portion of the citation makes little sense as written, and seems to relate only marginally to the topic at hand, but is not atypical of the kinds of discussions frequently found under this heading.

V. THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Within a planning area the land-use would be altered regardless of a transportation improvement, within a determined design time span. Therefore, a transportation improvement within this planning area would have no effect upon the long-term productivity.

The only effect that a transportation improvement could have is on the short-term productivity. The short-term productivity effect of the . . . Bypass would be a continued urbanization of the area. This proposed highway improvement will effect a safer and more efficient transportation of people, goods and services, and this in turn will provide the area with an attractiveness for continuing residential and commercial development.

It is to be noted that the recommended . . . Bypass alignment has been related to various Regional and local plans. Because of the cooperative approach that was employed in determining the recommended alignment the intermediate control points were established in order to minimize effects upon the areas traversed.

Examples are as follows:

* * *

4. Coordination with . . . County Conservation Department
5. . . . River crossing and associated flood plain area

* * *

7. Illinois Route . . .

* * *

9. Coordination with communities in regard to areas of "planned unit development" and industrial-manufacturing development.

The following citation is another example of the confusion which exists over how to approach the requirement for discussion of "the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." In this case the writer compared the inconvenience of the construction phase with the benefits of the facility in operation. Although this does evidence an understanding of the problem of tradeoffs over different periods of time, the time periods compared are not those most crucial from the environmental impact perspective.

> The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. This project to be constructed in a network of city streets will cause a normal amount of disruption and inconvenience to local traffic. With the adjacent streets, it is anticipated that the least inconvenience of minimum duration is to close this portion of . . . Avenue to through traffic, allowing the contractor to complete his work with minimum interruption and in the shortest possible time. As controlled by specifications the contractor will be required to provide access to local residents and emergency vehicles. Utilizing this shortest time span for the construction required will also limit the time of normal construction noise levels and exposed raw earth. In that the proposed cross section utilizes nearly the entire right of way, there will be little exposed area remaining necessary for a grassed ground cover to develop.

In the following citation one encounters a rather different problem with the question of short-term versus long-term relationships, i.e., inadequate consideration of the impact of regional long-term economic trends on the project in question. Although the sponsoring agency has identified three factors which seem likely to influence the long-term transportation picture in the Uintah Basin - water resources development, minerals and fossil fuel extraction, and increased leisure time - the analyses of their impacts are so general in nature that they raise far more questions than they answer. Looking at these factors in order, the water resources development project is supposed to result in "a totally new and radically different physical and economic appearance for some 10,000 square miles of what has heretofore been considered a backwash region." There is no indication given, however, of the kind of

growth expected or what type of transportation facilities it might require. Some idea of the anticipated load on the highway net, and by extension on the project in question, would be particularly desirable.

The analysis of minerals and fossil fuel extraction is excellent for the short term up to 1972, but what of the future? We are encountering shortages of both minerals and fuels at the present time. This will in all probability lead to rapid development of the resources found here. How will this material then be exported, i.e., what transportation facilities will need to be developed to handle the volume of shipments? What will be the anticipated effect on the highway net? Do the proposed project's design standards take this situation into account?

The leisure time analysis is the most tenuous of all, for it is based on an article in a national news magazine. Granting the national trend, what is the attitude in this state toward a four day week and how much extra traffic might it generate on the highways of the Uintah Basin?

In sum, while these analyses indicate in a general way that construction of the proposed project is in line with growth trends, and that no important long-term options for enhancing the productivity of the region are expected to be foreclosed by it, they fail to consider the specific long run impact of these three factors on the project in question. An answer to this query would, of course, require an assessment of the future overall transport picture for the Uintah Basin before the role of this highway was clear. Without a survey of the transportation alternatives, one can only speculate whether the design of the proposed improvement is a short-term solution which, in light of projected economic growth, will rapidly become obsolete, or is an adequate design for the long run.

In reviewing the project the Forest Service made this same point:

> "We support the plan to increase the standard of this road as proposed, but would like an indication of expected long-range needs. Construction to a higher standard in the future would probably necessitate further search for an alternate corridor."

The response of the sponsoring agency was not reassuring:

> "Design of the facility is for 1990 traffic and no predictions have been made beyond that for future long-range needs."

This is a typical result of planning on a project by project basis rather than with reference to some sort of a long-range master plan. And it can be costly. While a short-term solution will require less commitment of funds now, the rebuilding of an obsolete facility at some future date, and with inflated dollars, will require heavy capital expenditures, in all likelihood far exceeding the sum which would be necessary to construct an adequate design for the long run now. In this regard, note the Forest Service's warning about the probable need to seek an alternate route if future upgrading is to be undertaken.

PART V - SHORT-TERM ADVANTAGES VS. LONG-TERM OUTLOOK

Overshadowing all other considerations relative to this transportation corridor are the Central Utah Project and oil extraction.

Central Utah Project

Combining the water resources of the Uintah Basin tributaries of the Colorado River, the Central Utah Project plans for eventual water storage, power generation and recreation complexes to serve a growing economy in a growing region.

During the coming decade, multi-million dollar expenditures are to be allocated for dams, reservoirs, aqueducts and related facilities throughout northeastern Utah resulting in a totally new and radically different physical and economic appearance for some 10,000 square miles of what has heretofore been considered a backwash region. Portions of a brochure prepared by the U. S. Bureau of Reclamation are reproduced on the facing page.

Petroleum

The importance of Duchesne County and Uintah County will become of even greater significance with the increase in production of oil and minerals of which the following are representative samples:

> Crude oil hauled from the Blue Bell oil field in Duchesne County has increased from 2500 barrels per day in September, 1971 to 10,000 barrels per day in February of 1972.

March 197[illegible]

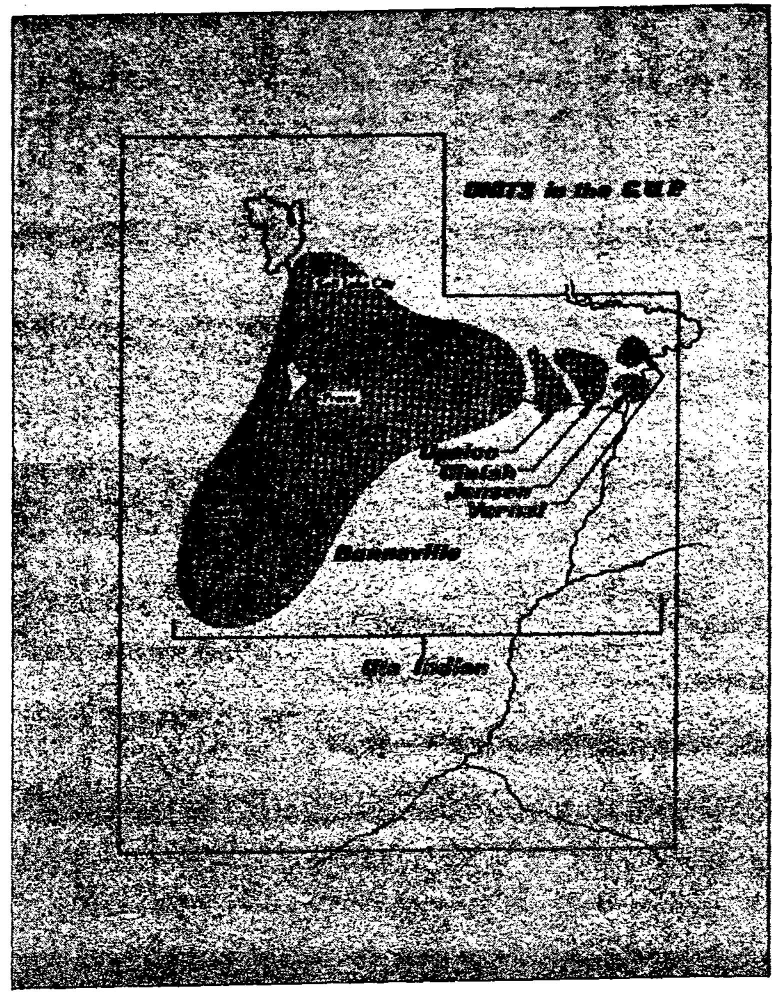
CENTRAL UTAH PROJECT

The *Central Utah Project*, planned and being constructed by the Bureau of Reclamation, is located in the central and east central part of Utah and is the most significant water resource development program in the State. The Project provides Utah the opportunity to use most of her allotted share of Colorado River water. Also it is the most feasible means of providing large amounts of additional water to the most highly developed part of the State where population growth and industrial development are accelerating at a rate far above the average for the State and the Nation. Utah's future industrial economy will be governed by the water that can be made available. Water developed by the *Central Utah Project* will be used for municipal and industrial purposes, irrigation, hydro-electric power, fish and wildlife, and recreation. Flood control and water quality control will also be benefited. It is estimated that construction costs of the *Central Utah Project* will probably exceed $1 billion.

The *Central Utah Project*, within limits of available water supply, could involve directly or indirectly practically all of Utah. To facilitate planning and construction, the project has been divided into six separate units. Four of these units—*Vernal*, *Bonneville*, *Jensen*, and *Upalco* — were authorized for construction in 1956 by the Colorado River Storage Project Act. The *Uintah Unit* was authorized in 1968 by the Colorado River Basin Project Act, subject to a finding of feasibility by the Secretary of the Interior. The *Ute Indian Unit* was also approved for a feasibility report by the 1968 act but has not yet been authorized for construction.

The *Jensen*, *Vernal*, *Upalco*, and *Uintah Units* are relatively small and are situated entirely within the Uinta Basin. They develop local in-basin water supplies for irrigation of Indian and non-Indian lands and for municipal and industrial purposes in Duchesne and Uintah Counties. The *Bonneville* and *Ute Indian Units* involve both the Uinta Basin and the Bonneville Basin and are very complex in plan, extensive in scope, and involve large expenditures of funds.

The Central Utah Water Conservancy District will administer the sale and delivery of Central Utah Project water, will operate and maintain most of the project facilities, and will contract with the United States Government for repayment of the reimbursable costs of the project. The district represents the people of the 12-county area of central Utah.



> Phosphate concentrates are presently being trucked through Daniel's Canyon at the rate of 25,000 tons per month. This is expected to increase to 30,000 tons per month by the time this final statement is released.
>
> Added to this is the likelihood of oil shale development. U. S. Route 40 will be one of three major transportation routes to serve the oil shale areas from the Wasatch Front.

Discussion of the future oil possibilities in northeastern Utah and western Colorado was contained in the Winter, 1972 Bulletin of Standard Oil Company of California which stated in part:

> "At Red Wash, about 30 miles southeast of Vernal, daily production from 145 wells now averages 5,500 barrels. In addition, there are 18 gas producing wells. As at Rangely, the Company has been assisting recovery by water flood in the Red Wash field since 1964 and plans to expand the flood to include 16 additional injection wells in 1972, for a total of 46. Production at Red Wash began in 1951."
>
> "The Uinta Basin continues to show promise as a consistent source of domestic petroleum reserves, and has become one of the country's busiest locales for onland drilling. Innovation and persistence are boosting recovery from known fields and raising hopes that further exploration will uncover new fields."

Four-Day Week

More emphasis on the four-day week implies greater use of 3-day weekends for recreational purposes which, in turn, implies increased use of Daniel's Canyon by vacationers and 4-day, 3-day commuters: those who live in town during the work week and live in a rural setting, many miles from their place of employment for the rest of the time.

An article which appeared in the February 7, 1972 issue of U. S. News and World Report reports how workers view a four-day week:

"Workers who have shifted to a four-day week appear to be overwhelmingly in favor of their new schedules, accordingly to a survey by a professor at the University of Pittsburgh.

"More than 70 percent of those consulted say they like their work more than before, and 60 percent say they have encountered few problems as a result of the switch-over to a shorter week.

"The percentage of respondents who say they do not like the four-day schedule: just over 6.

"The survey was conducted by James A. Wilson, an associate professor of business administration, and is reported in detail in the latest issue of Poor's Workweek Letter, Cambridge, Mass.

"More than 58 percent of the respondents said that absenteeism has decreased and 84 percent said most of their associates on the job liked the short schedule better than the traditional five-day week.

"The questionnaire was filled out by 588 respondents. They are employed by 51 U.S. companies.

Corridor Commitment — It would appear that the proposed highway improvement is but a small component of the overall picture and that the further commitment of this transportation corridor, which has been committed for many years, is in full accord with the long-term outlook.

The following excerpt is an adequate but somewhat superficial discussion of the short term-long term relationship. As in several of the examples previously cited, the writer appears uncertain just what is required here so he touches on a variety of topics in his presentation, some more germane than others. What sets this passage apart from the confused efforts noted earlier is the writers' feeling for the long-term and short-term consequences of the project, and the tradeoffs between them. The analysis would, however, benefit from greater depth. For example, the discussion of economic gains expected to result from the project almost completely overlooks the substantial effect this highway

is expected to have in the long run in opening up a long-neglected, depressed and transportation-shy area of the state.

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

During the construction phase of the supplemental freeway, many noticeable short-term disruptions of the environment could occur. Air pollution in the form of dust and emissions from the construction equipment will cease, once the project is completed. Water pollution of local streams may occur when the land is cleared of trees and vegetation cover for construction of the freeway, thereby making it susceptible to soil erosion, but this too will be resolved once the highway landscaping has an opportunity to become established.

The long term effect of the freeway facility upon the wildlife and natural vegetation of the area is expected to be minimal. The . . . Corridor is already under the influence of manmade development to such an extent that the additional highway should have a minimal disrupting effect upon the wildlife. The northern portion of the corridor is already densely populated, and the remaining forested areas are found only along streams and rivers. The southern portion of the corridor is more agrarian oriented, with larger areas of forestation. An attempt will be made to select an alignment within the corridor that does a minimum amount of damage to the forested areas. Once construction of the freeway is completed, the right of way will be landscaped with native grasses, shrubs, and trees. The revegetation of the right of way will help to provide an effective cover for the small wildlife of the area.

In the densely populated urban areas, it will be impossible to construct the freeway without having to displace some businesses and residences. During the design phase of the project, the careful selection of an alignment will help to keep the number of individuals displaced relatively low.

The short term economic gains that the area should experience cannot be overlooked. The demand for construction personnel and the need for service-connected facilities for both men and machines should show a marked increase. This should be of particular importance in the . . . area, which has had a long record of high unemployment among the minority groups. Recent efforts have been made to train these individuals for construction type jobs and employ them on public financed projects.

Construction of a supplemental freeway in the . . . Corridor will provide the area with the only fully access controlled facility that connects the . . . area to the downstate . . . area. The freeway will connect the large population centers in the north to the many recreational facilities located in the south. The new highway facility will likely result in the dispersement of the population and industry along the peripheral

> areas of the freeway. This dispersement of the residential and industrial areas will help somewhat to counteract the current environmental pollution problems of the metropolitan area that are associated with overcrowding. The land located along the freeway, especially in the interchange areas, will become extremely valuable for service connected establishments due to the access control features of the freeway. This increase in economic activity will create an increase in the tax base of the area and the additional tax revenue will in turn provide for social service expenditures.
>
> The construction of a supplemental freeway in the . . . Corridor will cause a decrease in the volume of traffic utilizing existing Illinois Routes . . . and . . . The decrease in traffic will relieve the congestion on the existing facilities, which in turn will create a much safer highway for local users.

In our final example taken from the design DEIS for F.A. Route 64 (Illinois Route 47) from the west junction with U.S. Route 150 in Mahomet to a point approximately 1.2 miles south of the Ford County line, the writer has concisely captured the spirit of the "relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity." The writer makes commendably clear the tradeoffs this project requires, and what the consequences will be in the short and long term.

> THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY:
>
> The majority of the land in the vicinity of the proposed improvement is used for agricultural purposes. This land use is of prime importance for present as well as future produce demands. However, the safety of the motoring public now and in the future must also be considered to be of prime importance. In this situation a balance must be reached whereby the productivity of the land and the safety of the motorist are provided for.
>
> A minimal quantity of additional right-of-way will be required if the recommended improvement is constructed. This retains the maximum acreage, consistent with improving the highway to adequate standards, in its productive form. The existing alignment best serves the desires of the motoring public and, with minor vertical and horizontal corrections, a safe roadway can be provided on this alignment.
>
> In this way we are providing both a safer roadway for future traffic and also leaving intact the means of producing food for the future population.

E. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES LIKELY TO RESULT FROM IMPLEMENTATION OF THE PROPOSED PROJECT

In addition to the problems associated with the short-term versus long-term relationship already alluded to, considerable confusion exists over NEPA's call for an assessment of "any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." A first example, taken from the DEIS for the Tijuana River Flood Control Project, neatly illustrates the irreversibility problem. By definition, an effect is irreversible or a resource commitment irretrievable if, once the project is undertaken, the effects cannot be eliminated by any available countermeasure. Thus, as the writer notes, the proposed channel could be obliterated by refilling it, or land use patterns resulting from improved flood protection could be reversed. In short, the removal of land from other uses is not an irretrievable commitment. On the other hand, no means are available to recreate an estuary or an extinct species of wildlife. These changes are irreversible.

> IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH SHOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED
>
> The irretrievable resources which will be lost as a direct result of construction of the channel are limited. A portion of the fresh water flow which would normally infiltrate into the ground water reservoir will be lost to the sea during periods in which the rate of runoff exceeds 30 cfs. Significant quantities of fresh water will be lost only during the occurrence of major floods.
>
> The loss of land resulting from the construction of the channel has been previously discussed. This loss, however, is not really irretrievable. The channel floor may be utilized for other purposes, and it is always possible to remove, fill in, cover over, or otherwise destroy such a structure so that the land may be converted to its former condition.
>
> Implementation of the recommended flood control plan will not directly result in the irretrievable loss of any archaeological, historical, or cultural features, or in the loss of any endangered species or any unique, valuable, or endangered wildlife habitats. It has been previously pointed out, however, that completion of the proposed measures will pose some indirect hazards to:

1. the quality of the soil on the valley floor and the ground water beneath the surface,

2. the conservation of open space and agricultural endeavors on the flood plain, and

3. the preservation of the estuary, including its habitats and endangered species.

The threat posed by the first two of these hazards would not really lead to an irreversible loss. No matter how the flood plain is developed, it would always be possible to eliminate the development and restore the plain to its present condition. It is also probable that any salts which accumulate in the surface layers of soil can be leached from the soil. Restoration, however, might be very expensive.

Construction of the flood control channel will greatly facilitate the development of the estuary into a residential marina. The complete or partial destruction of the estuary, enclosed habitats, and endangered species can be considered truly an irretrievable loss. The value of these losses has been previously discussed.

Not all projects are going to entail irretrievable commitments, however, and there is little to be gained by trying to dredge up material to fill this section, or by repetition of material from other sections of the EIS as in the example below. In sum, if there is no substantial irreversible and irretrievable commitment of resources associated with a project, say so and end it there.

Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented. There are no commitments of resources involved in this improvement which would be considered irreversible or irretrievable of any significance. That portion of Centennial park from which a grading easement is required involves only a grassed area which will be reseeded and replaced completely in as good as or better condition as prior to construction. The proposed sidewalk is considered by both the city and park to be an enhancement, and is entirely on city property, therefore, this cannot be considered as a loss of land resource. Those areas adjacent to private property are also considered as an enhancement to land value.

The following excerpt from the DEIS for the F.A.P. Route 410 Corridor from Columbia to Carbondale (Illinois) is one of the better assessments of "irreversible and irretrievable commitments of resources." The writer zeroes in quickly on the major resources affected, coal deposits and agricultural crop land, cites hard data on the magnitude of the effect where it is available and appropriate to a corridor statement, and closes with a discussion of the measures being taken to keep the commitment of resources to a minimum. If there is an oversight, it is the failure to discuss the value of the agricultural land to be taken and the implications for the local economy of its diversion to another use.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES WHICH WOULD BE INVOLVED SHOULD THE PROPOSED ACTION BE IMPLEMENTED

*** *** ***

Coal deposits and agricultural crop land are the main resources of the area which might be lost if a supplemental freeway is constructed in the Pinckneyville Corridor. Assuming a minimum right of way acquisition width of 300' for the 89 mile long corridor from Columbia to Carbondale, a total of 3,240 acres, excluding the land needed for interchange locations, may be required for the freeway. The freeway will closely parallel section lines and other natural land lines where possible in order to keep the total amount of crop land taken out of production to a minimum. Regardless of how much care is exercised, some of the farms in the corridor will suffer severence problems (which may result in ownership changes brought on by access problems).

There are considerable coal deposits located in the central and southern region of the study corridor. The majority of this coal is either in the process of being stripped or soon will be strip mined. Since the economy of the region is closely tied to the mining industry, an alignment will be selected that does a minimum amount of damage to the coal mining operations in the area. Economic considerations alone dictate that coal holdings must be avoided since the basic cost of developed coal property can amount to $2,000 to $2,500 per acre, and since court decisions have found that changes in mining operations necessitated by highway projects is a compensable item.

In recent years, man's forests and woodlands have been considered as a valuable natural resource that should be preserved. The main concentration of forest land is located in the southern half of the Pinckneyville Corridor. In a project of this mag-

nitude, it will be impossible to construct a freeway facility without damaging some of the forest land. Where it becomes necessary to locate the freeway alignment through a wooded area, the highway right of way will be revegetated with native grasses, shrubs, and trees.

1'75

IV

INFORMATION SOURCES:

STATE OF ILLINOIS

Writers and reviewers of EIS should take advantage of the various agencies in state government which have special authority, expertise, or information in environmental matters. The first section of this chapter identifies the responsibilities of mission oriented agencies in Illinois. The second section indicates the types of research and information available from the state surveys.

ILLINOIS STATE DEPARTMENTS AND AGENCIES

State Clearing House

The Federal Environmental Protection Act requires each state to establish an office to serve as a clearing house for environmental impact statements. In Illinois, the Governor's Office of Planning and Analysis (O.P.A.) performs state clearing house functions, including maintaining an up-to-date file of federal environmental requirements to ensure that EIS satisfactorily meet state and federal standards. This office does not, however, conduct reviews or comment on environmental impact statements written for or about Illinois projects. Apart from ensuring that such statements have been reviewed by the proper agency or agencies, O.P.A. presently functions only as a coordinating or sign-off agency.

Natural Resource Development Board

Created by the 75th Illinois General Assembly, the Natural Resource Development Board serves as an interagency coordinating and review body focusing on environmental standards in Illinois. The membership of this board is comprised of representatives of those executive agencies which administer programs that in some fashion affect or deal with the Illinois environment. The agencies currently represented are: the Illinois Department of Agriculture; the Illinois Department of Business and Economic

Development; the Illinois Department of Conservation; the Illinois Environmental Protection Agency; the Illinois Institute for Environmental Quality; the Illinois Department of Mines and Minerals; the Illinois Pollution Control Board; the Illinois Department of Public Health; the Illinois Department of Public Works and Buildings; and the Illinois Department of Registration and Education.

The Chairman of the Natural Resource Development Board is appointed by the Governor and at this writing the position is vacant. The Chief of the Division of Water and Natural Resources in the Illinois Department of Business and Economic Development is designated Technical Secretary of this Board, and the staff of that division supplies staff services to the Board.

By Illinois Statute the Natural Resource Development Board is charged with the following responsibilities:

-Preparing a biennial assessment of the adequacy of water supplies to meet State needs

-Recommending appropriate legislation, policies and programs to the Illinois Governor and General Assembly to ensure that State water needs are met

-Preparing and distributing pamphlets, films, reports, etc., concerning existing conditions affecting water and related land resources in Illinois

-Examining all proposed Federal and State legislation affecting water and related land resources in Illinois, and advising the Governor concerning such legislation

-Formulating and implementing policies, plans and procedures to effect maximum coordination and cooperation between all State agencies in the planning, development and management of water and related land resources

-Determining areas within the State where programs to develop and/or preserve water and related land resources are needed, and examining those programs already in process

-Reviewing and establishing priorities for all proposed State water resource projects and submitting recommendations thereon

to the Governor

-Representing Illinois in matters concerning any Federal multi-purpose project that deals with the State's water resources and related land areas

-Administering programs of financial and technical assistance to local governments for water resources planning and development

-Establishing, supervising and supporting regional water resource management commissions to plan for the development and management of regional water resources

The Natural Resources Development Board is also required to provide assistance and cooperation to any agency in Illinois concerned with environmental issues.

The Projects Task Force subcommittee of the Natural Resource Development Board is at the center of the EIS review process. Composed of appointed technical staff from each of the departments represented on the Board, it directly reviews all Federal and State environmental impact statements which are deemed important and relevant. In addition, the Projects Task Force reviews Federal and State multi-purpose water or related land projects for Illinois and reports its findings to the Natural Resource Development Board. It also reviews Federal A-95 programs, and suggests revisions to the State water plan. The work, staff and records of the Projects Task Force are administered by the Division of Water and Natural Resources in the Department of Business and Economics.

Illinois Department of Agriculture

The Department of Agriculture is involved in all food-stuff related activities in Illinois. Information and assistance is available in these areas: Feeds, Fertilizers and Standards; Grain Inspection; Markets; Meat, Poultry and Livestock; Food Processing Industries; Soil and Water Conservation; and Agricultural Statistics. Anyone dealing with these areas and seeking assistance should direct their inquiries to either:

Ill. Dept. of Agriculture
Junior Livestock Bldg.
State Fairgrounds
Springfield, Illinois 62706

or

Ill. Dept. of Agriculture
300 West Washington
Chicago, Illinois 60606

This department has not yet written any environmental impact statements, nor are any on file there. It is a member of the Natural Resource Development Board and the Projects Task Force and is therefore involved, through its Division of Soil and Water Conservation, in the review of EIS.

Illinois Department of Business and Economic Development

This department is concerned with Industrial Development, Community Development, Tourism, and Water Resources. Inquiries about these functions should be addressed to either:

222 South College Street
Springfield, Illinois 62706

or

30 North LaSalle Street
Room 808
Chicago, Ill. 60602

In addition, it plays an important role in the EIS review process in Illinois through its Division of Water and Natural Resources. This latter unit is charged with supplying the staff, keeping the records, and coordinating the work of the Natural Resource Development Board and its adjunct, the Projects Task Force. Copies of those environmental impact statements which the Projects Task Force has reviewed, as well as review comments, are on file in its offices. This is probably the most comprehensive and accessible collection of materials on environmental impact statements to be found in Illinois.

Illinois Department of Conservation

The Illinois Department of Conservation supervises programs dealing with Engineering, Fisheries, Forestry, Game, Surface-Mined Land Reclamation,

Parks and Memorials, Planning and Education. Through its affiliate, the Illinois Archeological Survey, all EIS are reviewed to ensure that archeological sites in Illinois either go undisturbed by a proposed project, or are investigated prior to construction of the project. Inquiries should be directed to:

Illinois Dept. of Conservation
102 State Office Bldg.
Springfield, Ill. 62706

or

State of Illinois Bldg.
Chicago, Illinois 60601

This department does not write environmental impact statements, nor are any kept on file with this department. It is, however, a member and participant in both the Natural Resource Board and the Projects Task Force.

Illinois Environmental Protection Agency (EPA)

As a member of the Natural Resource Development Board and the Projects Task Force, the Illinois Environmental Protection Agency is a component of the state EIS review process. In addition, this agency has been empowered by the Illinois General Assembly to investigate cases where it is suspected that water, air, noise and land quality standards are being violated. Information about state environmental quality standards, including those of the Illinois Pollution Control Board, can be obtained here. Copies of certain environmental impact statements are also on file in this agency. Inquiries should be directed to:

Air Pollution Control Bureau
E. Randolph and the Lake
Chicago, Illinois 60602

or

Water Pollution Control Bureau
2121 W. Taylor
Chicago, Illinois 60602

There are also EPA offices in Rockford, Aurora, Collinsville, Peoria, Champaign and Marion.

Illinois Institute for Environmental Quality (IIEQ)

The Illinois Institute for Environmental Quality has been established to conduct and contract research in any area concerning the environment. Initiative for such research may come from within the IIEQ itself, or upon request by the Illinois EPA, Pollution Control Board, or other state agencies. Library and information materials are also available through the IIEQ. Inquiries should be directed to:

Illinois Institute for Environmental Quality
309 West Washington Street
Chicago, Illinois 60602

The IIEQ is involved in the environmental impact statement review process through its membership on the Natural Resource Development Board and the Projects Task Force.

Illinois Department of Mines and Minerals

This department oversees the operations of the extractive and mineral processing industries in Illinois. Since the state's mineral wealth is chiefly in fossil fuel, it has special expertise in matters concerning coal and oil. Information can be obtained by writing:

Ill. Dept. of Mines & Minerals
112 State Office Building
Springfield, Illinois 62706

This department is also involved in the EIS review process by virtue of its membership in the Natural Resource Development Board and the Projects Task Force.

Illinois Pollution Control Board (PCB)

The Pollution Control Board sets, administers and enforces environmental quality standards. Copies of existing environmental quality standards can be obtained from the Illinois EPA. This agency also holds membership on the Natural Resource Development Board and the Projects Task Force.

Illinois Department of Public Health

This department's concerns in environmentally related areas include:

Health Administration, Public Health, Disease Control, Environmental Health, Food and Drugs, General Sanitation, Laboratory Sanitation, Milk Control, and Radiological Health. Information can be obtained from:

Illinois Dept. of Public Health
535 West Jefferson Street
Springfield, Illinois 62706
or
State of Illinois Bldg.
Chicago, Illinois 60601

This department is also represented on the Natural Resource Development Board and the Projects Task Force.

Illinois Department of Public Works and Buildings

This department not only participates in reviewing environmental impact statements as a member of the Natural Resources Development Board and the Projects Task Force, but also is actively involved in preparing them. Two of its divisions, Highways and Waterways, are required by federal law to develop EIS for projects they undertake. These divisions can either do the work themselves or contract it out.

The Division of Highways, by far the most active unit, maintains a file of EIS which it has produced. Federal environmental requirements, land use information, and related materials are available through this department.

Assistance and information can be obtained from:

Ill. Dept. of Public Works & Bldgs.
2300 South 31st Street
Springfield, Illinois 62706

Illinois Department of Registration and Education

Among its major tasks this department licenses Architects, Land Surveyors, Engineers, Real Estate Agents, Sanitarians, Tree Experts, and Water Well Contractors. Through its component agencies, the Geological Survey, the Natural History Survey, and the Water Survey, this department is also actively involved in environmental activities. This agency is a member of both the Natural Resource Development Board and the Projects Task Force. General information can be obtained from:

Ill. Dept. of Registration and Education
628 East Adams Street
Springfield, Illinois 61101

STATE SURVEYS

Illinois State Geological Survey

The Illinois State Geological Survey is the agency of State government responsible for supplying information and conducting research on Illinois' topography, rock types, minerals, and surficial deposits. It is under the direction of the Board of Natural Resources and Conservation in the Illinois Department of Registration and Education.

This agency carries on a wide-ranging research program, including studies in such areas as Environmental Geology, Groundwater Geology, Engineering Geology, Topographic Mapping, Mineral Resources, Mineral Production, and Industrial Minerals, as well as general research on Illinois geology. In addition, the Geological Survey has an information service, an educational extension office, and a publications service. Publications, available to the public free of charge, include: Bulletins, Circulars, Illinois Petroleum Reports, Industrial Mineral Notes, Mineral Economic Briefs, Environmental Geology Notes, reprints of journal articles by staff members, and miscellaneous materials. Lists of publications, information, professional assistance, technological data, and U.S. Geological Survey Topographic maps for all Illinois quadrangles can be obtained through:

Illinois State Geological Survey
Natural Resources Building
Urbana, Illinois 61801
AC 217/344-1481

or

115 South Washington Street
Naperville, Illinois 60504

Illinois Natural History Survey

The Illinois Natural History Survey is directly involved in the study of wild animal and plant populations in Illinois. It provides information services to farmers, homeowners, sportsmen, and industry.

The Applied Botany and Plant Pathology Section studies, identifies, and catalogs Illinois plants, maintains a watch for possible harmful species, such as new varieties of weeds, monitors plant diseases, and develops control measures. The Aquatic Biology Section conducts research on methods of maintaining, protecting, and increasing populations of sport and commercial fisheries. The Economic Entomology Section conducts research on insects whose presence may have a significant economic impact, and on methods for controlling them. The Faunistic Surveys and Insect Identification Section is concerned with the identification of suspected harmful animals and insects, the preparation of scientific reports on various animal groupings, and the maintenance of the State's research collections of animal specimens. The Wildlife Research Section deals with the wild animal resources of Illinois, in particular the study of the relationship between wildlife species and their habitats.

Information on published research, information services, news services, available films, and a list of Survey publications can be obtained by writing:

Illinois Natural History Survey
Natural Resources Building
Urbana, Illinois 61801
AC 217/333-6880

Illinois State Water Survey

The Illinois State Water Survey has as its primary concern the water resources of Illinois. Foremost in its research efforts are identification of and planning for future water needs. Research and service programs involve studies of ground and surface water resources, water use and conservation, development of water supplies, and the meteorologic factors affecting water resources.

The Hydrology Section deals with surface runoff, groundwater, evaporation, and sedimentation. The Chemistry Section conducts research in the physical, chemical, radiological, and biological quality of water resources. The Hydraulic Systems Section designs and tests devices for controlling water flow through spillways, and other problems

in water flow. The Atmospheric Sciences Section studies cloud physics, rainfall variations, severe storms, and other weather conditions which affect water resources. The Water Quality Section works on projects dealing with water pollution and disturbed water quality relationships.

Additional information and listings of available publications may be obtained by writing:

Illinois State Water Survey
Box 232
Urbana, Illinois 61801
AC 217/333-2210

BIBLIOGRAPHY

AGENCY GUIDELINES

Army Corps of Engineers, Investigations, Planning & Development of Water Resources--Preparation and Coordination of Environmental Impact Statements, Office of the Chief of Engineers, Washington, D.C., Reg. No. 1105-2-507, May 28, 1971.

Army Corps of Engineers, Preparation and Coordination of Environmental Statements, Office of the Chief of Engineers, Washington, D.C., Reg. No. 1105-2-507, January 3, 1972. (under revision).

Army Corps of Engineers, "Engineer Regulations on Preparation & Coordination/Environmental Statements," Federal Register, Vol. 37, No. 22, February 2, 1972.

Army Corps of Engineers, Environmental Guidelines for Civil Works Program of the Corps of Engineers, Office of the Chief of Engineers, Washington, D.C., Reg. No. 1165-2-500, September, 1972.

Army Corps of Engineers, Guidelines for Assessment of Economic, Social, and Environmental Effects of Civil Works Projects, Office of the Chief Engineers, Washington, D.C., Reg. No. 1105-2-105, September 1972.

Army Corps of Engineers, Water Quality Considerations for Construction and Dredging Operations. Prepared by the U.S. Environmental Protection Agency, Water Quality Office, Southeast Region, Federal Facilities Branch, Revised April, 1971.

Atomic Energy Commission, "Implementation of the National Environmental Policy Act - AEC," Federal Register, Vol. 36, No. 180, September 9, 1971.

Atomic Energy Commission, Guide to the Preparation of Environmental Reports for Nuclear Power Plants, Directorate of Regulatory Standards, Washington, D.C., August, 1972.

Atomic Energy Commission, "Amendments to Its National Environmental Policy Act Regulations - AEC," Federal Register, Vol. 36, No. 190, September 30, 1972.

Atomic Energy Commission, "Calvert Cliffs' Coordinating Committee, Inc., et al., Petitioners v. United States Atomic Energy Commission and U.S.A., Respondents. Baltimore Gas and Electric Company, Intervenor -- No. 24,839 and No. 24,871," United States Court of Appeals for the District of Columbia Circuit; decided July 23, 1971.

Bureau of Sport Fisheries and Wildlife, Atlanta Region Guidelines (Section 2.352), Atlanta, Georgia, mimeo, no date.

Council on Environmental Quality, "CEQ Interim Guidelines - Statements on Proposed Federal Actions Affecting the Environment," Federal Register, Vol. 35, No. 92, May 12, 1970.

Council on Environmental Quality, "Statements on Proposed Federal Actions Affecting the Environment: Guidelines," Federal Register, Vol. 36, pp. 7724-7729, April 23, 1971.

Council on Environmental Quality, "Implementation of the National Environmental Quality Act - Notice for Public Comment on Procedures for Preparation," Federal Register, Vol. 36, No. 239, December 11, 1971.

Council on Environmental Quality, Memorandum for Agency and General Counsel Liaison on National Environmental Policy Act (NEPA) Matters, Washington, D.C., May 16, 1972.

Council on Environmental Quality, "CEQ's Implementation of NEPA," Federal Register, Vol. 37, No. 204, October 20, 1972.

Environmental Protection Agency, Policy and Procedures for the Preparation of Environmental Impact Statements for EPA Activities DRAFT, Management and Organization Division, U. S. EPA, Washington, D.C., November 11, 1971.

Environmental Protection Agency, "Environmental Statements, Procedures for Preparation," Federal Register, Vol. 37, No. 13, January 20, 1972.

Environmental Protection Agency, "EPA Guidelines for the Preparation of EISes," Federal Register, Vol. 38, No. 11, January 17, 1973.

Environmental Protection Agency, Environmental Impact Statement Guidelines, Region X (Seattle) EPA, Revised edition, April, 1973.

Environmental Protection Agency, Environmental Assessments for Effective Water Quality Management Planning, Washington, D.C., April, 1972. Prepared by the Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio.

Environmental Protection Agency, Environmental Impact Review Guidelines for Sewage Facilities, (draft), Region IX (San Francisco) EPA, no date.

Environmental Protection Agency, Health Guidelines for Water Resources and Related Land Use Management, Division of Water Hygiene, Water Quality Office, U. S. EPA, Washington, D.C., February, 1971.

Environmental Protection Agency, Procedures for Preparation and Review of Environmental Assessments for Water Quality Management Plans and Municipal Waste Water Projects, Office of Air and Water Programs, U. S. EPA, Washington, D.C. DRAFT - March 2, 1972.

Environmental Protection Agency, Reviewing Environmental Impact Statements at the Regional Level: Appraisals, Evaluations, Comments after 15 months with NEPA, by Hurlon Ray, Assistant Regional Administrator for Management, U. S. EPA, Region X (Seattle), April, 1972.

Federal Aviation Administration, Airport Construction Controls to Prevent Air and Water Pollution, Department of Transportation, Washington, D.C., AC *NO: 150/5370-7, April 26, 1971.

Federal Aviation Administration, Procedures for Considering Environmental Impacts, Office of the Secretary, Department of Transportation, Washington, D.C., Order 5610.1A, October 4, 1971.

Federal Aviation Administration, Procedures for Considering Federal Aviation Administration Environmental Impacts, Department of Transportation, Washington, D.C., Order 1050, November, 1971.

Federal Highway Administration, Guidelines for Implementing Section 102 (2)(C) of the National Environmental Policy Act of 1969, Section 1653 (f) of 49 U.S.C., Section 470f of U.S.C., and Section 309 of the Clean Air Act of 1970, Department of Transportation, Washington, D.C., PPM 90-1, August 24, 1971.

Federal Highway Administration, Interim Noise Standards and Procedures for Implementing Section 109 (i) Title 23 U.S.C., Department of Transportation, Washington, D.C., PPM 90-2, April 26, 1972.

Federal Highway Administration, Guidelines for Social and Environmental Analysis, Draft Research Proposal, Office of Environmental Quality, Department of Transportation (TEU-11), Washington, D.C., May 25, 1972.

Federal Highway Administration, Process Guidelines (Economic, Social, and Environmental Effects on Highway Projects), Department of Transportation, Washington, D.C., PPM 90-4, September 21, 1972.

General Accounting Office, Improvements Needed in Federal Efforts to Implement the National Environmental Policy Act of 1969, a report to the Subcommittee on Fisheries and Wildlife Conservation, Committee on Merchant Marine and Fisheries, House of Representatives, May 18, 1972.

General Services Administration, General Services Administration Preparation and Submission of Environmental Impact Statements as Prescribed by the Council on Environmental Quality (CEQ) Guidelines, Office of Environmental Affairs, Washington, D. C., August 10, 1971.

Department of Housing and Urban Development, "Departmental Policies, and Enhancement of Environmental Quality," Circular 1390.1, Washington, D.C., approximate date received: June, 1972.

Illinois Department of Transportation, Illinois Department of Transportation Guidelines--Environmental Impact Statement, Springfield, Ill., April 17, 1973.

Department of the Interior, "Departmental Manual, pt. 516: - Environmental Statements, Issuance of Departmental Directives Regarding Preparation," Federal Register, Vol. 19, No. 345, 1971.

President's Water Resources Council, Policies, Standards & Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources, Senate Document 97,87:2, May 29, 1962.

Department of Transportation, Transportation & Environment: Synthesis for Action. Impact of National Environmental Policy Act of 1969 on the Department of Transportation, April, 1971. Prepared by Arthur D. Little, Inc., Washington, D.C. Available from National Technical Information Service (NTIS), Springfield, Virginia 22151, NTIS Call No. PB 201 832.

Water Resources Council, Environmental Statements--Framework Studies and Assessments and Regional or River Basins Plans, WRC Policy Statement, Washington, D.C., February 10, 1971.

Water Resources Council, "Proposed Principles and Standards for Planning Water and Related Land Resources," Federal Register, Vol. 36, No. 245, pp. 24144-24194, December 21, 1971.

ENVIRONMENTAL ASSESSMENT METHODS

Ackoff, Russell, Scientific Method: Optimizing Applied Research Decisions, New York: John Wiley & Sons, 1962.

Arthur D. Little, Inc., Transportation & Environment: State Government Implementation of the National Environmental Policy Act of 1969, (volume 5), Washington, D.C., September, 1972.

Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio, Design of an Environmental Evaluation System, June 30, 1971. Prepared by Ira L. Whitman et al. for the Bureau of Reclamation. Available from National Technical Information Service (NTIS), Springfield, Va. 22151, NTIS Call. No. PB 201 743.

Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio, Environmental Assessment for Effective Water Quality Management Planning, Washington, D.C., April, 1972. Prepared for the Environmental Protection Agency.

Coombs, C. H., Howard Raiffa, & R. M. Thrall, "Mathematical Models and Measurement Theory," in R. M. Thrall et al., eds., Decision Processes, New York: John Wiley & Sons, 1954, pp. 19-38.

Ditton, Robert B., and Thomas L. Goodale, eds., Environmental Impact Analysis: Philosophy and Methods, Green Bay, University of Wisconsin Sea Grant Program, 1972.

Freeman, A. Myrick, III, "Project Design and Evaluation with Multiple Objectives," in Haveman & Margolis, Public Expenditures and Policy Analysis, Chicago: Markham, 1970, pp. 347-363.

Hill, Morris, A Method for Evaluating Alternative Plans: The Goals Achievement Matrix Applied to Transportation Plans, Ph.D. Dissertation, University of Pennsylvania, 1966.

Leopold, Luna, et al., "A Procedure for Evaluating Environmental Impact," U. S. Geological Survey Circular 645, U.S.G.S., Washington, D.C.

McHarg, Ian, Design with Nature, New York: Natural History Press, 1969.

Ortolano, Leonard, & William W. Hill, An Analysis of Environmental Statements for Corps of Engineers' Water Projects, IWR Report 72-3, Institute for Water Resources (C.O.E.), Alexandria, Va., June, 1972. Available from NTIS, Springfield, Va. 22151, NTIS Call No. AD 747 374.

Smith, Douglas C., Urban Highway Design Teams, Highway Users for Safety & Mobility, Washington, D.C.

Sorensen, Jens, A Framework for the Identification and Control of Resource Degradation and Conflict in the Multiple Use of the Coastal Zone, Department of Landscape Architecture, University of California, Berkeley, July, 1971.

Sorensen, Jens, and Mitchell Moss, "Development of Procedures and Programs to Assist in the Preparation and Review of Impact Statements." Paper prepared for American Association for the Advancement of Science Symposium, The National Environmental Policy Act: At the Interface of Law & Science, Washington, D.C., December 27-28, 1972.

Stanford Research Institute, Methods of Evaluation of the Effects of Transportation Systems on Community Values, Menlo Park, California, 1971, 57 p. Prepared by G. E. Klein et al. for Department of Housing and Urban Development.

Sullivan, James B., & Paul A. Montgomery, "Surveying Highway Impact," Environment, November, 1972, pp. 12-20.

The Conservation Foundation, "Highways and the Environment: How State and Federal Officials Assess the Impact of Urban Highways," Conservation Foundation Newsletter, Washington, D.C., November, 1972.

IMPACT STATEMENTS

Army Corps of Engineers, Los Angeles District, Tijuana River Flood Control Project, San Diego County, California. Prepared by The Science Division, Ocean Science & Engineering, Inc., Draft Environmental Statement, April, 1971, NTIS Call No. PB 200-440.

Federal Highway Administration, Ogden: The 12th Street Corridor, Ogden (Utah) Area Transportation Study, Suite 800, First Security Building, 405 South Main, Salt Lake City, Utah 84111, January, 1971. An appendix to the DEIS listed below.

Federal Highway Administration, Ogden (Utah): The 12th Street Corridor, Draft Environmental Statement & Administrative Action, August, 1971, NTIS Call No. FHWA-Ut-EIS-72-05-D.

Federal Highway Administration, Federal Aid Route 64 (Illinois Route 47) from the west junction with U. S. Route 150 in Mahomet to a point approximately 1.2 miles south of the Ford County line. The entire improvement within Champaign Co., Ill. Draft Design Environmental Impact Statement, August, 1971.

Federal Highway Administration, Federal Aid Route 64 (Illinois Route 47) from the west junction with U. S. Route 150 in Mahomet to a point approximately 1.2 miles south of the Ford County line. The entire improvement within Champaign Co., Ill. Final Design Environmental Statement & Administrative Action, March, 1972, NTIS Call No. FHWA-Ill-EIS-71-20-F.

Federal Highway Administration, Columbia to Carbondale, Illinois F.A.P. Route 410, Draft Corridor Environmental Statement, April, 1972.

Federal Highway Administration, City of Champaign, Champaign Co., Illinois Federal Aid Urban Route 8320 from Duncan Rd. (F.A.U. 8801) to Mattis Avenue, Draft Design Environmental and Section 4 (f) Statement, May, 1972.

Federal Highway Administration, Federal Aid Route 171 (Illinois Route 76) Belvidere Bypass, Boone County, Ill., Draft Design Environmental Statement & Administrative Action, July, 1972.

Federal Highway Administration, U. S. Trunk Highway 212 in Yellow Medicine, Chippewa & Renville Counties, Minnesota, Draft Design Environmental Statement, November, 1972, NTIS Call No. FHWA-Mn-EIS-72-13-D.

Federal Highway Administration, Reconstruction of Kirby Avenue, City of Champaign, Champaign County, Illinois Federal Aid Urban Route 8320 from Duncan Road (F.A.U. 8801) to Mattis Avenue, Final Design Environmental and Section 4 (f) Statement & Administrative Action, December, 1972, NTIS Call No. FHWA-Ill-EIS-72-36-F.

Federal Highway Administration, U. S. Route 40: McGuire Canyon to Strawberry Valley, Utah, Final Design Environmental Statement and Administrative Action, January, 1973, NTIS Call No. FHWA-Ut-EIS-72-02-F.

Forest Service, Palzo Restoration Project, Vienna Ranger District, Shawnee National Forest, Williamson Co., Illinois, Draft Environmental Statement, January, 1972.

Forest Service, Palzo Restoration Project, Vienna Ranger District, Shawnee National Forest, Williamson Co., Illinois, Final Environmental Statement, July, 1972, NTIS Call No. EIS-Il-72-5421-F.

City of Green Bay, Wisconsin, East Mason Street Project from South Jackson Street to Bellevue Street, Environmental Impact Analysis, April, 1973.

Hogan, C. M., L. Patmore, and H. Seidman, Environmental Impact Analysis for the 12th Street Corridor, Ogden, Utah, Environmental Systems Laboratory, Sunnyvale, California, February 29, 1972.

Institute of Aviation, University of Illinois, Champaign-Urbana, Illinois, Improvements Fiscal Year 1972-73 A.D.A.P. for University of Illinois-Willard Airport, Draft Environmental Statement, May, 1972.

Soil Conservation Service, Upper Salt Creek Watershed, Cook, Lake, & DuPage Counties, Ill., Draft Environmental Statement, November, 1972.

IMPACTS-selected references relevant to impact statements cited in Chapter III

Air Pollution

Brodine, Virginia, "A Special Burden." Air pollution is known to affect health; a recent medical conference reviewed new evidence as to how it takes its toll . . . . Environment, Vol. 13, No. 2, March, 1971, pp. 22-24, 29-33.

U. S. Government Printing Office, Air Pollutants Affecting the Performance of Domestic Animals: A Literature Review, Washington, D.C., 1972, Revised edition, 109 p.

U. S. Government Printing Office, Handbook of Air Pollution, Washington, D.C., 1968, 235 p.

Department of Highways, Ontario, Canada, Transportation Air Pollution, Report RR 169.

Turner, Bruce D., Workbook of Atmospheric Dispersion Estimates, U. S. Public Health Service, Washington, D.C. Available from NTIS, Springfield, Va. 22151

National Academy of Sciences, Lead in Gasoline: A Symposium, Bethesda, Maryland, Summer, 1971.

Water Pollution

Coutant, Charles C., "Evaluating the Ecological Impact of Steam Electric Stations on Aquatic Systems." Paper prepared for the American Association for the Advancement of Science Symposium, The National Environmental Policy Act: At the Interface of Law & Science, Washington, D.C., December 27-28, 1972.

Crossland, Janice, & Julian McCaull, "Overfed." Eutrophication: what it is, what causes it, how serious it is, and what can be done about it, Environment, Vol. 14, No. 9, November, 1972, pp. 30-37.

Environmental Protection Agency, Water Quality Criteria Data Book, Volume 1--"Organic Chemical Pollution of Freshwater," Washington, D.C., 1971, 379 p.; Volume 2--"An Investigation into Recreational Water Quality," Washington, D.C., 1972, 256 p.

Kelly, Robert A., "Potentials of Systems Analysis in Evaluation of Aquatic Environmental Impacts." Paper prepared for the American Association for the Advancement of Science Symposium, The National Environmental Policy Act: At the Interface of Law & Science, Washington, D.C., December 27-28, 1972.

Noise Pollution

Bragdon, C. R., Noise Pollution: The Unquiet Crisis, Philadelphia: University of Pennsylvania Press, 1970.

Burns, W., Noise and Man, London: Muray, 1968.

Chalupnik, J. D., Transportation Noise: Symposium on Acceptability Criteria, Seattle: University of Washington Press, 1970.

Department of Commerce, The Noise Around Us, Report of the Panel on Noise Abatement, September, 1970, CTAB-71-1.

Environmental Protection Agency, Laws and Regulatory Schemes for Noise Abatement, Washington, D.C.: Government Printing Office, 1972, 580 p.

Environmental Protection Agency, The Economic Impact of Noise, Washington, D.C.: Government Printing Office, 1972, 104 p.

Environmental Protection Agency, Effects of Noise on People, Washington, D.C.: Government Printing Office, 1972, 153 p.

Environmental Protection Agency, Fundamentals of Noise: Measurement, Rating Schemes and Standards, Washington, D.C.: Government Printing Office, 1972, 163 p.

Environmental Protection Agency, The Social Impact of Noise, Washington, D.C.: Government Printing Office, 1972, 25 p.

Environmental Protection Agency, Transportation Noise and Noise from Equipment Powered by Internal Combustion Engines, Washington, D.C.: Government Printing Office, December, 1971.

Galloway, W. J., W. E. Clark, & J. S. Kerrick, Urban Highway Noise: Measurement, Simulation, and Mixed Reactions, National Cooperative Highway Research Program, Report no. 78, 1969.

Galloway, W. J., C. G. Gordon, B. A. Kuger, & D. L. Nelson, Highway Noise: A Design Guide for Engineers, National Cooperative Highway Research Program, Report no. 117, 1971.

Department of Housing & Urban Development, Noise Assessment Guidelines, Washington, D.C.: Government Printing Office, 1971.

Kryter, K. D., The Effects of Noise on Man, New York: Academic Press, 1970.

Lang, J., & G. Jansen, Report on the Environmental Health Aspects of Noise Research and Control, World Health Organization, United Nations, 1967.

National Institute for Occupational Safety & Health, Criteria for a Recommended Standard Occupational Exposure to Noise, Department of Health, Education and Welfare, Washington, D.C., 1972.

Schultz, T. J., HUD Noise Assessment Guidelines: Technical Background, Office of Research & Technology, U.S. Department of Housing & Urban Affairs, Washington, D.C., 1971.

Department of Transportation, Transportation Noise and Its Control, Washington, D.C., June, 1972.

Ward, W. D., Evaluating the Noises of Transportation, U.S. Department of Transportation, Washington, D.C., Report no. 6ST-NA 70-2, 1970.

Welch, B. L., & A. S. Welch (Eds.), Physiological Effects of Noise, New York: Plenum Press, 1970.

Mineral Pollutants

Ahmed, A. K., D. F. MacLeod, & James Carmody, "Control for Asbestos," Environment, Vol. 14, No. 10, December, 1972, pp. 16-27, 27-29.

Grant, Neville, "Mercury in Man," Environment, Vol. 13, No. 4, May, 1971, pp. 2-15.

Vibration Impacts

Nicholls, I. R., C. F. Johnson, & W. I. Duvall, Blasting Vibrations & Their Effects on Structures, Bulletin 659, Bureau of Mines, U.S. Department of Interior, Washington, D.C., 1971

Impact of Roadway Deicing Salts

Environmental Protection Agency, Environmental Impact of Highway Deicing, EPA Publication 11040 GKK, Washington, D.C.

Highway Research Board, Effects of Deicing Salts on Water Quality & Biota, Literature Report & Review & Recommended Research, National Co-operative Highway Research Program, Report 91, Washington, D.C., 1970.

McConnell, H. H., & Jennifer Lewis, " . . . Add Salt to Taste." The use of salt to clear snow-bound roadways adds one more pollutant to the environment, while the benefits in safety may be illusory. Environment, Vol. 14, No. 9, November, 1972, pp. 38-44.

Economic & Social Impact

Department of Highways, State of Michigan, The Economic & Environmental Effects of One-Way Streets in Residential Areas, Lansing, Michigan, no date.

Highway Research Board, Effects of Proposed Highway Improvements on Property, Highway Research Program Report 114, Washington, D.C,

Highway Research Board, Relocation: Social & Economic Aspects, Special Report no. 110, Washington, D.C.

Wilson, Everett K., Sociology--Rules, Roles, Relationships, Homewood, Ill., Dorsey Press, 1966.

Impact on Parks & Recreation Areas

U. S. Government Printing Office, Park and Recreational Facilities: Their Consideration as an Environmental Factor Influencing the Location and Design of a Highway, Washington, D.C., 1971, 48 p.

GENERAL REFERENCES

General Accounting Office, Adequacy of Selected Environmental Impact Statements Prepared under the National Environmental Policy Act of 1969, Report to the Subcommittee on Fisheries and Wildlife Conservation, Committee on Merchant Marine and Fisheries, House of Representatives, November 27, 1972.

General Accounting Office, Improvements Needed in Federal Efforts to Implement the National Environmental Policy Act of 1969, Report to the Subcommittee on Fisheries and Wildlife Conservation, Committee on Merchant Marine and Fisheries, House of Representatives, May 18, 1972.

U. S. Government Printing Office, A Directory of Information Resources in the United States: Physical Sciences, Engineering, Washington, D.C., 1971.

U. S. Government Printing Office, An Engineering Victory for our Environment: A Citizen's Guide to the U. S. Army Corps of Engineers, Washington, D.C., 1972.

Green, Harold P., The National Environmental Policy Act in the Courts, Washington, D.C.: The Conservation Foundation, May, 1972.

Kreith, Frank, "Lack of Impact," Environment, Vol. 15, No. 1, January/February, 1973, pp. 26-33.

White, Gilbert F., "Environmental Impact Statements," The Professional Geographer, Vol. XXIV, No. 4, November, 1972, pp. 302-309.